CANADIAN ARCTIC EXPEDITION

I. Report of Northern Division

II. Report of Southern Division

BY

DR. R. M. ANDERSON

III. Report on Topographical and Geographical Work

BY

GEO. H. WILKINS

OTTAWA
J. DE LABROQUERIE TACHÉ
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1917

Reprinted from:
"8 George V, Sessional Paper No. 38, A. 1918. REPORT OF THE DEPARTMENT OF THE NAVAL SERVICE FOR THE FISCAL YEAR ENDING MARCH 31, 1917. Printed by order of Parliament. Ottawa: J. de LaBroquerie Tache, Printer to the King's Most Excellent Majesty. 1917. (No. 38-1918)---A 1-2"

Re-paged:
I, pp 3-8, for original pp. 22-27;
II, " 11-47 " " " 28-64;
III, " 51-56 " " " 65-70.

With Compliments
R. M. Anderson
Ottawa
16th January 1918

I. Report of Northern Division

CANADIAN ARCTIC EXPEDITION.

The Canadian Arctic Expedition, under the leadership of Vilhjalmur Stefansson, set out for the Arctic regions on the 20th July, 1913.

The work planned comprised the exploration of Beaufort sea, the investigation of animal life in the areas covered, and the taking of soundings over the regions explored. The expedition was also to ascertain if lands hitherto unknown exist, and to definitely mark any found. The investigating and areal mapping of the copper-bearing and associated rocks of the mainland between cape Parry and Kent peninsula for approximately one hundred miles inland, and of the southern and eastern shores of Victoria island were also to be undertaken.

The work was so varied both in the nature of the investigations and the area to be explored that it was decided to divide the expedition into two parties; one, known as the Northern division, to carry out the Beaufort sea work; the other, known as the Southern division, to work on the coast survey.

SOUTHERN DIVISION.

The Southern division have completed the work and have returned from the north. A complete report of operations by Dr. R. M. Anderson, executive head of the Southern division, is appended hereto.

NORTHERN DIVISION.

The Northern division, in C.G.S. *Karluk*, sailed from Nome, Alaska, on the 20th July, 1913. Shortly after rounding point Barrow the vessel became ice-bound. It was carried eastward along the coast to near Thetis island, where it became stationary and was apparently frozen in for the winter. Mr. Stefansson, accompanied by B. M. McConnell, George H. Wilkins, and D. Jenness, set out on a hunting trip to the mainland. During their absence the vessel was carried away and the hunting party were obliged to make their way westward along the coast to Collinson point, where they joined the Southern division, who were wintering there.

The *Karluk* was carried far to the westward, and on the 11th January, 1914, was crushed by the ice, and sank. The men in the vessel transferred supplies, ammunition and other necessities to the quarters prepared on the ice, and they settled down in their igloos to await the return of the light.

Some of the men were not satisfied with the inaction of life in the camp, and expressed a desire to set out for land, dimly visible in the Arctic twilight. Two parties were therefore formed, each composed of four men, and set out for land, the first party on the 21st January and the second on the 5th February. These men have not since been heard from, and have been given up for lost.

When the light had improved the remaining members set out for land and succeeded in reaching Wrangel island. Through the efforts of Captain R. A. Bartlett, who journeyed on foot to the Siberian coast and thence to East cape, to get in touch with the outside world, a relief expedition was organized and the men were rescued from the island.

The following men were lost in attempting to reach Wrangel island: Charles Barker, John Brady, Alex. Anderson, A. King, Dr. F. MacKay, James Murray, H. Beauchat, and T. S. Morris. B. Mamen and G. Malloch died from nephritis on Wrangel island, and George Breddy was accidentally shot.

The survivors were John Munro, R. Williamson, W. McKinley, F. E. Maurer, John Hadley, R. Templeman, H. Williams and E. F. Chafe.

ICE EXPEDITIONS.

Immediately upon his arrival at Collinson point, Mr. Stefansson began preparations for a trip on foot over Beaufort sea to the north. Although the fate of the *Karluk* was not then known, he realized that, owing to ice conditions, the party therein would probably be unable to carry out the exploration work. He purchased the *North Star*, partly for the supplies which went with the vessel, and also for the use of the vessel itself.

On the 22nd March, 1914, the ice party, composed of V. Stefansson, Storker T. Storkerson, and Aurnout Castel, set out. Their intention was to continue as far out across the ice as circumstances would permit and, if possible, to land on Banks or Prince Patrick island, where they would spend the summer. In the event of their failing to return before the break up of the ice, a vessel was to be sent to Banks island during the summer.

On the journey across the ice the party covered an area previously unexplored, and travelled as far to the west of Banks island as safety would permit. When the ice began to break up, toward the end of April, the party were obliged to make for land. They landed on Norway island on the northwest coast of Banks island on the 25th June.

The summer was spent in mapping the coast line of Northern Banks island and in carrying on investigations in the interior of the island, up the "Wilkins" river; this river empties near Norway island.

In September, 1914, the party travelled south to Kellett, where George H. Wilkins and a party in the *Mary Sachs*, sent north with supplies were met. A winter base was established at Kellett, and the *Sachs* was beached. The Vessel was considerably damaged on the way north, and required repairs.

On the 22nd December, 1914, Mr. Stefansson, accompanied by an Eskimo, Natkusiak, made a journey across southern Banks island to DeSalis bay to locate any Eskimos wintering in that vicinity. Before leaving he gave instructions to the party at Kellett to prepare for an ice trip over Beaufort sea, to begin early in February. He arrived at DeSalis bay on the 3rd January, 1915, and crossing over Prince of Wales strait followed the shore of Victoria island for some miles. Finding no indications of the presence of Eskimos he returned to Kellett, arriving on the 27th January.

Preparations for the ice trip having been almost completed during his absence, the few remaining details were arranged, and the party, composed of V. Stefansson, Storker Storkerson, Ole Andreasen, and Charles Thomsen set out north for cape Alfred early in February, following the west coast of Banks island. From cape Alfred they journeyed in a northwesterly direction until the 26th April, when the break up of the ice obliged them to make for Prince Patrick island. They landed on Prince Patrick island near Land's End, and thence followed the shore northeast to cape McClintock. They proceeded for three days north from this point, when land unmarked on the charts was discovered. A complete report, giving details of the journey, is contained in the Naval Service Annual Report of March 31, 1916. Owing to the lateness of the season and the necessity for arranging the next season's work, the party set out on the return journey without carrying on any extensive investigations. They arrived at Kellett on the 8th August.

On the 19th August the *Polar Bear*, in charge of Captain Lane, arrived at Kellett. As the services of a vessel were urgently required by the Northern division (the *Mary Sachs* had not been relaunched), Mr. Stefansson purchased the *Bear*, and set out for Baillie island. Upon arrival there he left instructions for the *North Star*, for which Mr. Wilkins had gone to the base of the Southern party on foot early in the spring, to go to Banks island without communicating with him. He returned to Kellett, whence he set out for the north in the *Bear* on the 3rd September.

It was intended at first to land at Kellett and proceed north along the west coast of Banks island. Up to this time, since late July, the coast had been kept free from ice by prevailing easterly winds, but on the 3rd September the wind changed and blew from the northwest, with a heavy fall of snow. Upon reaching cape Kellett it was seen that the ice was coming in, and the party took shelter behind the cape for the night. By the morning the ice was pressed close to the west coast, debarring further progress. Fearing that with a slight change of the wind they might be shut in, Mr. Stefansson decided to make an attempt to get north through Prince of Wales strait, along the east coast of Banks island. It has since been learned that the freeze-up on the west coast of Banks island came on the 6th September, and the ice did not leave the coast until the spring of 1916.

A course was set for Nelson head, which was rounded on the night of the 4-5th September and the vessel proceeded north into the straits. South of N. Latitude 72° only scattered ice was encountered, but north of 72° there were large packs of heavy ice called "paleocrystic", that is, ice that has lasted through several summers, during which time it has been freed from most or all of its salt and become hard and glare. On September 5 there was a strong southeast wind which kept the water along the Victoria island coast free of ice, and on the night of the 5th the party took shelter near the land just south of Deans Dundas bay. On the 6th September considerable time was lost in navigating through scattered ice, and during the afternoon the wind changed to the west, bringing down heavy masses of ice from the Banks island side. They were able to proceed only as far as Princess Royal island, where the vessel was tied up for the winter and the party prepared to make their winter quarters there.

As soon as it was decided to winter near Princess Royal island the party set out to obtain as much caribou meat as possible, but as it was past the season for caribou, which had already gone south, only twenty-three were obtained. All the drift-wood that could be found within 15 miles on either side of the winter quarters was gathered. A base was established some 10 miles southwest of Armstrong point. This base was in an ideal location to complete the mapping of the northeast coast of Victoria island. Mr. Stefansson instructed Storker Storkerson to undertake this survey as soon as the ice would become frozen over sufficiently to enable them to travel.

The land east of the base near Armstrong point is high and rocky, so that crossing it by sled in the early fall would not be practicable. The survey party were therefore obliged to wait until Melville sound north of Peel point froze over, which did not happen until the middle of October.

On the 10th October the party left camp, Storkerson and Herman Kilian to make the complete trip, Noice and Andreasen for the supporting party. At Hornby point on the 24th October the supporting party turned back. Storkerson and Kilian returned on the 4th December without having been able to quite complete the work, but an effort was to be made to complete it in the spring of 1916.

During the survey the chief difficulties encountered were darkness and continual gales. At one point the party were stormbound for twelve successive days by a head gale which the dogs would not face. Drawings of the hitherto unexplored coast line covered were made by Mr. Storkerson, and will be published with the final report of operations.

Mr. Stefansson himself made several trips during the autumn of 1915. The first trip was for hunting purposes, on which he was accompanied by natives, whom he established in a sealing camp at Hay point. Later on this camp was moved to Ramsay island, and in November he made a trip south, following the curves of the coast until he found a party of Eskimos, numbering about

one hundred, in Minto inlet, south across the neck of land from the foot of Walker bay. Two of the Eskimos returned with the party to the *Polar Bear*, Captain Gonzales later made a trip to the village for trading purposes, but considerable difficulty arose owing to the natives not having been accustomed to dealing with white men. Unfortunately, the natives contracted severe colds about the same time that the party from the *Polar Bear* visited them, and they superstitiously attributed their sickness to the presence of the white men. Should any of them die from cold or hunger resulting through their being unable to obtain game through illness, their white visitors would be blamed and the natives would refuse to trade further with them. Mr. Stefansson, however, did all in his power to overcome this friction between the natives and the *Polar Bear* party, and no serious results occurred.

On the 1st December, Mr. Stefansson left Ramsay Island hunting camp for Kellett. The chief purpose of this trip was to get two sleds which Captain Beneard was making for use on the ice trip the following spring. The party consisted of Stefansson, Noice, Martin Kilian, and an Eskimo. On the first part of the journey many difficulties were encountered. The party intended to follow the south coast of Banks island around as far as DeSalis bay and thence cross to the west coast by practically the same route as that used by Mr. Stefansson the previous winter in his journey across southern Banks island. Before reaching the Banks island coast, however, they broke the runner of one of the sleds, thus making it necessary to put a double load on the remaining sled. In order to avoid a second accident of this nature they decided to cross overland the whole way, as the going was smoother than on the sea ice. On this journey they were further handicapped by the death of their best dog. This dog was capable of drawing three hundred pounds, while the average dog is capable of drawing only between two hundred and two hundred and fifty pounds. In Mr. Stefansson's opinion the ice journeys for the summer of 1916 would be considerably shortened by the loss of this animal.

On the journey across Banks island it was ascertained that the map, as given in Admiralty chart No. 2118, is somewhat out on the southeast coast. This chart calls for a width of about thirteen miles due west between Ramsay island and Banks island, while in reality the distance is at least twenty-five miles. The error seems to be that this whole portion of Banks island should be moved north on the map until Milne point is nearly where Schuyler point is now placed. The party climbed the slope of Banks island from the first bay indicated north of Milne point. There really is no bay there, but only the low land at the mouth of a small river. They ascended the valley of this river for about ten miles. After the first four miles the river runs through a narrow and crooked ravine. Although the grade is considerable, the party were unable owing to the fog and blizzard, to obtain a definite idea of the exact elevation. Mr. Stefansson, however, judged that within ten miles from the coast they had attained an elevation of over four thousand feet. The journey across Banks island entailed a great amount of climbing up and down hills. The party finally came down into a river valley some seven or eight miles back of DeSalis bay. From the point where they came to it this river runs about south into the bay, but following up stream they went first north then northwest and finally about west some ten or twelve miles until the valley widened into a continuous flat, which extends to the ocean some forty-five miles southeast from the tip of cape Kellett. The slope of this flat is to the east until within some fifteen miles of the west coast. It is from one to four miles wide and is flanked by hills rising three hundred to five hundred feet over the lowland. For the last fifteen miles there is a river flanked by low banks, which are apparently water-swept each spring. This river comes into a small bay without any abrupt descent, so the party did not at first realize that they had reached the sea. On this journey it was found that by following this route there is a pass from DeSalis bay east through the high southern part of Banks

island without ascending to a height of more than three hundred feet. Although the actual elevations were not obtained, the knowledge of this pass will be of great value to any one needing to cross Banks island. The total distance, following the river that flows into DeSalis bay, is about thirty-five or forty- miles.

Upon their arrival at Kellett the party found all well at that base. They were told that the *North Star* was unable to proceed more than twenty miles beyond Norway island on the west coast of Banks island, as the ice north of that point did not move during the whole summer of 1915.

On the 6th January, Mr. Stefansson sent Thomsen, Noice, and Knight across Banks island to DeSalis bay en route to the *Polar Bear*, near Armstrong point. On the way they were to close up the hunting camps at Ramsay island. Thomsen carried a letter of instruction to Storkerson to assemble such things in the way of an outfit for the ice journey as were not provided by the *North Star* or *Sachs* and bring them with two dog teams to cape Alfred.

In the meantime the party at cape Kellett, under the immediate supervision of Mr. Stefansson, prepared for the journey to cape Alfred. These plans unfortunately did not materialize owing, in the first place, to delays experienced by Thomsen and party, who did not arrive at the *Polar Bear* until the first of February. These delays were caused by bad weather which prevented the party finding Ramsay island. For about five days they were in plain sight of it had the weather been clear. They also encountered open water about four miles beyond Milne point, which obliged them to considerably lengthen the trail. Storkerson, at the *Polar Bear*, had in the meantime much trouble getting from Mercy bay the sleds cached there the previous year. The chief obstacle was the mountainous character of the intervening land, which was practically uncrossable in the midwinter darkness, and through the roughness of the ice between point Russell and Mercy bay when that route was later adopted.

When Storkerson received the instructions sent by Mr. Stefansson the dogs were in poor condition for travel. On the journey up to point Russell in an endeavour to carry out the instructions received from Stefansson, Storkerson lost several dogs, which rendered continuation of the journey practically impossible. As he erroneously considered that Mr. Stefansson would prefer the failure of the ice trip to the failure to explore the new land, and as he considered that both could not be carried out with the dogs in such poor condition, he took upon himself to alter the plans and instead of going west started for the new land. Upon arrival, he commenced investigation of the new land, sending a sled in charge of Hermann Kilian to Mercy bay with a letter of information for Stefansson, which he would pick up on his way east.

In the meantime Mr. Stefansson and party were waiting for the arrival of Storkerson at cape Alfred. While they were waiting, hunting camps were established around cape Alfred in order to provide fresh meat for the ice trips planned. The party waited until the 7th March, when the season was already late to start on the ice. By this time considerable anxiety was felt on account of the non-arrival of Storkerson, as it was feared that Thomsen had failed to reach the *Bear* with instructions for him. On the 7th March, Stefansson started for Mercy bay to learn whether any of the men had visited the bay. The remainder of the party busied themselves in carrying supplies east to be used in the new-land work. The *Star* was temporarily abandoned and the party belonging to her were sent to Melville island to assist in the new-land work.

On the 20th March the Stefansson party met Castel a little east of cape McClure. He reported that he had been unable to recognize any point on the coast from the chart; that he had reached a bay which he thought might be Mercy bay and had gone ten miles into it, but finding no trace of sleds, and the dog feed having given out, he returned.

From Castel's observations and those of other parties it appears that for forty-five or fifty miles west of Mercy bay no point on the chart could be iden-

tified by the contour of the coast as shown on Admiralty chart No. 2118. It appears that the big bay shown by chart No. 2118 as just east of cape McClure does not exist, although there is a bay of considerable size about six miles west of Mercy bay. This unmarked bay is the one from which Castel turned back. On the west side of it he cached a fifty-gallon drum of kerosene which was intended generally for the use of the Eskimos of Melville island in the summer of 1916. On meeting Castel, who had seen no trace of Storkerson, Mr. Stefansson gave up hope of his arrival, and sent orders to cape Alfred to break camp and commence moving to Melville island.

He also left instructions that when established on Melville island the party were to put up dried meat for the winter supply.

At Mercy bay the letter left by Storkerson, explaining the reason for the change in plans, was found. From this letter Mr. Stefansson understood that by proceeding to cape Ross, Melville island, he could get in touch with Mr. Storkerson through men stationed there to protect supplies, or through travelling parties.

Mr. Stefansson, accompanied by Wilkins, Castel, Kilian, Natkusiak, and Emiu, with three sleds, accordingly proceeded to cape Ross, arriving there on the 13th April. The party found the remains of a camp, a small cache and a note from Storkerson saying he had gone towards the head of Liddon gulf, but there was little or no information which would aid them in co-operating with him.

As there has been a heavy fall of snow the party could not tell, from following the trail, how many sleds Storkerson had. It was therefore impossible to determine if he intended to return to cape Ross or proceed to the new land. Under the circumstances, Mr. Stefansson decided that the best plan would be to send one sled in charge of Natkusiak to the head of Liddon gulf, where the dogs could be well fed and rested, while he himself would make a quick journey back along the trail leading to the *Polar Bear* until they would come across information which would guide them. Before they proceeded far, however, they were met by Herman Kilian, who had come directly from the Storkerson party. Kilian reported that Storkerson, with Thomsen, Andreasen, Noice, and Illun had left the head of Liddon gulf on the 14th April for the new land, intending to keep on advancing and to map as much country as possible so as to be home at the *Polar Bear* on the 10th July. Mr. Stefansson therefore decided to overtake Storkerson if possible as he planned to land at the north end of Melville island between the 15th and 20th July, which meant that his season of exploration work would be at least one month longer than Storkerson's. In case the new land proved extensive he did not purpose returning to Melville island, giving the whole summer to exploration work.

The party in charge of Stefansson left cape Ross for the north on the 19th April. They reached the head of the gulf in three days, crossed the portage near point Nias, and arrived at the new land on the 2nd May at the same point as the previous year. They met Storkerson on the 3rd May at cape James Murray, which appears to be the southwest corner of the new land. Arrangements were immediately made to carry out exploration and charting work. Thomsen, with one team, was sent to Kellett to carry scientific specimens from the *North Star* to the *Mary Sachs*, and also to carry the reports of the expedition to Kellett in order that they might be sent out by the first ship calling there.

The department has received no later reports from Mr. Stefansson. It is expected that a complete survey of the newly discovered land will be made, and that journeys over the ice to the west, covering parts of Beaufort sea hitherto unvisited, may be carried out. It would appear that Mr. Stefansson does not intend to leave the region until every detail of the work planned has been completed.

II. Report of Southern Division

BY

DR. R. M. ANDERSON

THE CANADIAN ARCTIC EXPEDITION OF 1913.

REPORT OF THE SOUTHERN DIVISION.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

SIR,—I have the honour to submit a report upon the work of the Southern Division of the Canadian Arctic Expedition of 1913-16.

The Canadian Arctic Expedition of 1913-16 was planned to work in two comparatively distant and distinct fields, and the nature of the investigations to be undertaken was so varied that the expedition was divided into two parties.

The Northern party, under command of Mr. Vilhjalmur Stefansson, were to explore the Beaufort sea and also carry on investigations into the animal life of this region and take soundings in the districts investigated. They were also to ascertain if islands hitherto unknown exist, and to definitely mark any found. This division of the expedition was thus to confine its work largely to the oceans and archipelagos north of Alaska and the Western Arctic region of Canada.

The work of the Southern party, under my direction, was to be confined more exclusively to the Arctic mainland and adjacent islands, as set forth in the following instructions:—

> "The relative importance of the investigations for this party are: (1) geological, (2) geographical, (3) anthropological, (4) biological, (5) photographical.
>
> "The work of the Southern party shall be primarily the investigation and areal mapping of the copper-bearing and associated rocks of the mainland between cape Parry and Kent peninsula and for approximately one hundred miles inland and on southern and eastern Victorialand.
>
> "The work undertaken by these parties should be of a high order for this class of exploration, and should mark a distinct advance over previous work. To secure such results the geological and topographical sub-parties should follow closely the regular scheme for field parties engaged in reconnaissance work adopted by the Geological Survey. In working from the base depot, these parties should be practically complete distinct and independent units. . . . The anthropological work shall consist of ethnological and archaeological research. . . . The biological work shall consist of marine and terrestrial biology, etc., etc."
>
> The chief of the southern party, as executive head, must afford every reasonable facility as circumstances permit to enable these sub-parties to carry out the above important work."

Ample provision was made for the scientific work of the party by selecting competent specialists for each branch of science to be studied, and providing them with all necessary instruments and such equipment and provisions as had by experience been found most suitable for use under the climatic conditions expected. The scientific staff of the Southern party as originally organized was as follows: Geologist, John J. O'Neill, of Ottawa, who had specialized in Pre-Cambrian geology and copper rocks; topographers, Kenneth G. Chipman

and John R. Cox, men of several years' experience in the topographical division of the Geological Survey; anthropologists, D. Jenness, of New Zealand, an Oxford man with field experience in ethnology in New Guinea, and M. Henri Beuchat, of Paris, a writer of note on American archaeology; marine biologist, entomologist, and botanist, F. Johansen, a former member of the Danish East-Greenland Expedition of 1906-08 under Mylius Ericksen and later entomologist for the United States Department of Agriculture; meteorologist and magnetician, William Laird McKinlay, of Glasgow; photographer and cinematographer, George H. Wilkins, of Adelaide, Australia; mammalogist and ornithologist, Dr. Rudolph Martin Anderson, of the Victoria Memorial Museum of Ottawa. The latter, having had several years previous experience in exploratory work in Arctic, Alaska, Yukon Territory, and the Northwest Territories, was appointed to take charge of the Southern party in the absence of Mr. Stefansson.

Owing to the unavoidable complications arising from the unfortunate drift and loss of the *Karluk*, M. Beuchat and Mr. McKinlay were unable to join the Southern party at Herschel island as contemplated, and Mr. Wilkins was only able to be with the Southern party for a part of the time. Mr. Jenness was able to cover much of the ethnological work as planned, by taking over part of M. Beuchat's field, and by division of labour of the whole party complete meteorological records were kept for nearly three years. The magnetic instruments were lost on the *Karluk*, and consequently that branch of science is lacking in the final results.

As the expedition was not formally taken up by the Dominion Government until February, 1913, the time was rather short for assembling the multitude of articles of supply and equipment required. Although most of the members of the scientific staff were members of the Geological Survey, the general direction of the expedition was in the hands of the Department of the Naval Service. With the exception of technical instruments and equipment supplied to certain members by the Geological Survey, practically the whole of the equipment, including provisions, clothing, field gear, etc., was supplied by the Department of the Naval Service.

Some difficulty was experienced in obtaining large quantities of pemmican, dehydrated vegetables, and other condensed foods on short notice, and a vast assortment of miscellaneous goods had to be provided, "everything from a needle to an anchor," as there was no certainty of being able for three years to replenish articles consumed or left behind. Practically everything requisitioned was assembled at H.M.C. Dockyard, Esquimalt, B.C., in June, 1913. The expedition is under great obligation to Mr. J. A. Wilson, Director of Stores, Department of the Naval Service, Ottawa, and to Mr. George Philips, Naval Store Officer, Esquimalt, B.C., for their efficiency and care in seeing that articles for the expedition were supplied promptly and of excellent quality, both at the start of the expedition and later, as well as for encouragement and friendly and intelligent co-operation with the work of the expedition outside of the extent of their official duties. George J. Desbarats, C.M.G., Deputy Minister, Department of the Naval Service, is also to be thanked for continued interest and prompt attention to the work and needs of the expedition throughout more than three years of our absence in the north. Through their efforts the Canadian Arctic Expedition was probably as completely and well equipped as any expedition that has ever gone into the north.

Most of the members of both the Northern and Southern parties of the expedition, with a large part of the equipment and supplies, sailed from Esquimalt, B.C., June 17, 1913, on the steam-whaler *Karluk*, which had been purchased for the use of the Northern party. Additional supplies were shipped from Victoria and Seattle to Nome on one of the Alaska Steamship Company's vessels. The *Karluk* arrived safely at Nome on July 9. The gasolene schooner *Alaska*, which had been built in 1912 for the Bering Sea trade and to carry

the United States mail to Kotzebue sound, had been under option for the use of the Southern party, and was purchased at Nome, Alaska. Its dimensions were: Length, 57 feet 5 inches; draught, 6 feet 6 inches; gross tonnage, 50; beam, 17 feet; construction, wooden auxiliary schooner; 50 horse-power standard gas engine.

Considerable additional supplies and equipment, including reindeer skins and skin clothing, sleds, dogs, distillate, coal oil, and a large supply of dried dog salmon, were obtained for the expedition at Nome. As the numbers of the party had been much increased over the originally planned number, with correspondingly increased equipment, the gasolene schooner *Mary Sachs* was also purchased in Nome as an auxiliary vessel for both parties. The *Mary Sachs* had the following dimensions: Length, 56 feet 6 inches; draught, 5 feet 6 inches; beam, 18 feet 1 inch; gross tonnage, 41; construction, wooden, gasolene, screw vessel; 30 horse-power Union gas engine.

The *Karluk* and *Mary Sachs* sailed from Nome July 20, and calling at port Clarence, sailed from there July 27. The C. G. S. *Alaska* left Nome on July 19, arriving at Teller, Alaska, July 24. Here it was found necessary to dismantle and overhaul the engine and put on a better propeller before proceeding farther. This involved discharging and reloading cargo, and the *Alaska* did not get away from port Clarence before August 11, rounded point Barrow August 20, and passed Flaxman island September 6. No ice was met until we were near the Seahorse islands, a little south of Barrow, Alaska, but east of point Barrow the prevailing westerly and northwesterly winds had packed the ice along the shore, so that there was very little open water anywhere. For the first time since 1888, when the whalers began going in to Herschel island annually, no vessel from the west was able to get in to Herschel island, and some small vessels which had spent the preceding winter east of Herschel island were unable to go out. The vessels caught between Herschel island included the 247-ton steamer *Karluk*, belonging to the expedition, the 420-ton steam-whaler *Belvedere*, the gasolene schooners *Polar Bear*, *Anna Olga*, *Elvira*, and *North Star*, the *Alaska* and *Mary Sachs* of the expedition, and the *Teddy Bear* east of the Mackenzie river. Of these the *Elvira* was crushed and sank in October, 1913, near Humphrey point, Alaska, and the *Karluk* drifted west and sank northeast of Wrangell island in January, 1914.

The ice encountered in Beaufort sea in 1913 was too heavy to be bucked successfully by any vessel, no matter of what strength of hull or power of engines. There are no true icebergs in the western Arctic ocean, such as are broken off from the peripheral glaciers of Greenland or the Antarctic continent. The immense sheets of flat ice which are formed, however, crack extensively with the rise and fall of the tides. These tide-cracks frequently open widely or close abruptly by the force of the winds, crushing the edges of the floe like glass, and forcing up great blocks to form pressure-ridges which may be 30 to 40 feet high. Snow-drifts fill up the crevices of the ridge, and as the snow melts and settles in the spring, the whole becomes cemented into a floe that is too massive to thaw in a single short summer season, and may last over for several years.

These large masses of ice in the shoal waters off the north coast of Alaska and Canada, if not too thick and numerous, are to a certain extent an advantage to small vessels, as they cut down the swell in heavy weather, and often ground in comparatively deep water some distance from shore, allowing vessels of small draught on a harbourless coast to tie up behind them, sheltered from winds and from ice crushing from outside. By creeping slowly along the shore, moving ahead a little whenever the wind and tide loosened and shifted the ice a little along the coast, the *Alaska* and the *Mary Sachs* succeeded in getting as far ahead as Collinson point, 69° 59′ N. Lat., 144° 50′ W. Long., in

Camden bay, on the north coast of Alaska, about ninety miles west of the Alaska-Yukon Territory international boundary, and decided to go into winter quarters at Collinson point on September 10, three or four days before the freeze-up.

The *Alaska* and *Mary Sachs* secured a sheltered harbour in a small bay behind the Collinson point sandspit; the vessels were unloaded, and the men secured comfortable quarters for the winter in a large log-house built of drift-wood. Large quantities of Mackenzie river driftwood on all the beaches of the north Alaska coast furnish abundant fuel. The cariboo have been largely exterminated along this section of the coast, but some mountain sheep and cariboo meat was secured from inland Eskimos, and large numbers of ptarmigan and fish were obtained in season. The health of all members of the party was excellent throughout the year, the only illness or casualty being that of Andre Noram, cook of the *Mary Sachs*, who became insane, with symptoms indicating paresis, and committed suicide by shooting, April 16, 1914, at Collinson point.

Although it was a disappointment to the members of the party to be held up by the ice before getting into Canadian territory, the time was improved by the men in becoming used to Arctic conditions—the methods of sledging with dogs, camping, and taking scientific observations at low temperatures. A large number of astronomical observations, solar and stellar, and a series of lunar occultations were taken at Collinson point, during the winter, for astronomical position and variation of compass and chronometer. An automatic tide-registering machine was kept in commission for a considerable time, meteorological records were kept up, and various collections were made. A snow-house makes a very good observatory, but at low temperatures great care must be exercised in handling delicate instruments, as the faintest breadth or even the insensible perspiration from a bare hand near the instrument will coat lenses and metal work with a film of frost crystals. Even guns are left out of doors all winter because if brought inside they become immediately coated with a thick mass of hoar-frost and ice, which takes a long time to melt, thoroughly wets the weapon inside and out as it melts, and rusts it badly if it is not taken entirely apart and thoroughly cleaned and oiled.

Desiring to begin work in Canadian territory as soon as possible, J. J. O'Neill started from Collinson point with a dog-driver and assistant in February, to begin geological work by a reconnaissance of Firth river (more generally known locally as Herschel island river), coming from the Endicott mountains near the international boundary and emptying into the Arctic ocean near Herschel island. This was carried out successfully, as well as a geological reconnaissance of Herschel island.[1]

K. G. Chipman and John R. Cox left Collinson point on March 16 and proceeded to Demarcation point. A series of solar observations for chronometer ratings were taken at the international boundary monument, the 141st meridian of west longitude. A stop was again made at the boundary when the party was sailing out, August 4, 1916, to get time sights again at the same place over twenty-eight months later. The coast line was surveyed to the eastward, tying in Herschel island with the surveys of the Alaska-Yukon International Boundary Survey of 1912. Mr. Cox then joined Mr. O'Neill in completing the topographical work on Firth river, and completed the coast survey by sled to Escape reef at the western edge of the Mackenzie river delta, where a gasolene launch was in readiness to work in the delta as soon as the river broke out.

Mr. Chipman and Mr. O'Neill later in the spring did some geological work in the Black Mountain district west of the Mackenzie delta until the river broke out about June 1. They then proceeded by whaleboat through the east branch of the Mackenzie, charting it as far as the south end of Richard island, after

[1] Summary Rep. Geol. Surv., Dept. of Mines, for 1914. Ottawa, 1915, pp. 112–115, 148–149. *Ibid.*, 1916, pp. 236–237.

which they proceeded to Arctic Red river and to fort McPherson near the mouth of Peel river, to pick up some consignments which came down by one of the Mackenzie river steamers. A launch which had been purchased for Mr. Chipman's survey party could not be made to run, and not as much territory was covered as expected, but with an expert sailor of the delta as guide, the utmost advantage was got from the whaleboat, and large portions of the middle and east branches were mapped, with a number of cut-off channels and smaller channels used in winter sled or summer whaleboat travel. At the same time Mr. Cox, with competent Eskimo guides, surveyed the west or Aklavik branch of the delta from Akpavachiak or Escape reef up to the mouth of Peel river. Astronomical positions were determined at Arctic Red river and fort McPherson and at several points in the delta, tying the work of the boundary survey with the work of previous explorers in the lower Mackenzie and Peel river country:[1]

There is a good 6-foot channel over the shoals around Tent island, near the mouth of the west branch of the Mackenzie delta, and passing these there is a deeper channel as far south as the outlet of Great Slave lake. Passing shoals of about five feet depth at that place, there is a deep channel again as far south as fort Smith, at the foot of the Grand rapids of the Slave river, 60° North latitude, near the northern boundary of Alberta. The channel into the east branch of the Mackenzie delta is also deep enough for fair-sized schooners, and the new Hudson's Bay Company's post at Kittigazuit on the east side of the delta southeast of Richard island is supplied from Herschel island by this route. The middle channel of the delta was not completely surveyed for lack of time, as the boat survey parties were obliged to meet the *Alaska* at Herschel island early in August to go east of the Mackenzie into the Coronation gulf region, where the main work of the Southern party was planned to be done.

Mr. D. Jenness, after coming ashore with Mr. V. Stefansson from the *Karluk* in September, 1913, had spent most of the winter in doing linguistic work among the Eskimos in the point Barrow region. Towards spring he came east to Collinson point and did ethnological and archaeological work from Collinson point to Demarcation point in the spring, later in the summer carrying on some extensive archaeological excavations at Barter island, Alaska, making large collections in the ruins at the site of the ancient trading rendezvous between the Mackenzie Eskimos and the western Alaskan Eskimos. Mr. F. Johansen made extensive collections of plants and insects, rearing many species of insects to study their life-histories and development. Some marine dredging was also done. During the fall and winter Chipman and Cox had prepared a map of the harbour at Collinson point and vicinity on the scale of $\frac{1}{24000}$, extending it inland to include some ten square miles of tundra, with 20-foot contours. The harbour was thoroughly sounded. It is not suitable for large vessels, carrying only about seven feet of water at the entrance, but is deeper inside of the lagoon. Vessels of somewhat larger size may obtain shelter by going behind some of the small islands in the chain extending west from Flaxman island. Further extended work along this section of the coast was not undertaken by the Canadian Arctic Expedition, for the reason that the well-known explorer and geologist, Mr. Ernest deKoven Leffingwell, who first came to Flaxman island on the Mikkelsen-Leffingwell Expedition in 1906, had spent most of his time from 1906 to 1914 with headquarters at Flaxman island, working on the geology of the Arctic coast of Alaska, and had prepared a very minute and accurate map of the coast, channels, and islands of the section from the Colville delta east, including a very complete series of soundings of all the channels. These charts and geological results are now in course of publication by the United States Geological

[1] Summary Rep. Geol. Survey, Dept. of Mines, for 1914. Ottawa, 1915, pp. 148–149.
Ibid., Report for 1915. Ottawa, 1916, pp. 237–239.

Survey, but the expedition was very much aided in 1913-14 by information received and tracings of unpublished charts kindly loaned to us by Mr. Leffingwell for our work on the Alaskan coast.

During the spring and summer of 1914, the routine and executive work of the southern party devolved upon me, including the apportionment of supplies and equipment for three vessels. The 10-ton gasolene schooner *North Star* had been purchased by Mr. Stefansson from its owner, Capt. M. Anderson, who was wintering in Clarence bay, a little east of Demarcation point. As a consequence, the time for zoological field work and the preparation of specimens was limited; nevertheless, 212 birds representing 52 species, and 77 mammals representing 13 species were collected and preserved. Nests and eggs of many of the species of breeding birds were also collected.[1]

The expedition vessels *Alaska* and *Mary Sachs* left Collinson point on July 25, 1914, the first day that the ice moved off the beach far enough to let us out of the harbour. The vessels had been free of the ice inside of the harbour since July 7. After some delays occasioned by ice, which was thick and close to the beach around Martin point, Icy reef, and Demarcation point, the *Alaska* reached Herschel island 69° 34′ N. Lat., 138° 54′ W. Long., August 5, and the *Mary Sachs* a few hours later. The *North Star* had got in from Clarence bay a little before. These expedition vessels were the first vessels to come into Canadian waters in the western Arctic flying the Canadian flag. The steam-whaler *Belvedere*, of Seattle, which had taken on a quantity of auxiliary supplies, coal, distillate, etc., from Nome in 1913 for the expedition, and had been compelled to winter in the ice a little off shore west of Icy reef, had come through safely and landed our stores at Herschel island about the last of July.

Herschel island is quite a busy place in July and August. Eskimo-owned and sailed boats, to the number of twenty-five or more, whaleboats, and perhaps a dozen two-masted Mackenzie-built schooners, were assembled here to trade with incoming ships. With the recent decline in the whaling industry in the western Arctic, and smaller probability of ships wintering at Herschel island, the Eskimos from the Mackenzie delta and from the westward had a still greater incentive to be at the island to trade during the short open season. In 1915, one year after the expedition went in, the Hudson's Bay Company started an innovation by spreading out on to the Arctic coast, and established a western Arctic district headquarters at Herschel island and another post 150 miles east of the Mackenzie river at cape Bathurst (Baillie islands), 70° 35′ N. Lat., 128° 05′ W. Long. Another post has been established at Kittigazuit (the point Encounter of Sir John Richardson) on the eastern edge of the Mackenzie delta, and the site of one of the largest villages of the Mackenzie Eskimos. In 1916, the Hudson's Bay Company moved 400 miles farther east along the coast and established another new post at the station just vacated by the Southern party of the Canadian Arctic Expedition at Bernard harbour, Dolphin and Union strait, 68° 47′ N. 114° 50′ W. These new posts of the company are supplied by a gasolene motor schooner, the *Fort McPherson*, from the large storehouses at Herschel island, stocked by chartered ships sent up from Vancouver, B.C. It is to be assumed that the commercial prospects of this region in the fur-trading line are of considerable importance. The presence of trading posts in hitherto untouched regions will facilitate the more detailed exploring and prospecting of districts which were formerly impossible except to specially equipped expeditions.

As previously reported,[2] Mr. Stefansson, after his separation from the *Karluk*, had established a base camp at Martin point, Alaska, with supplies

[1] Summary Report Geol. Survey, Dept. of Mines, for 1914. Ottawa, 1915, pp. 163–167.

[2] Report of the Dept. of the Naval Service for the fiscal year ending March 31, 1916. Ottawa, 1916, pp. 16–19, 71–75.

obtained from Collinson point, and from the *Belvedere* and *North Star* outfits, and started north from Martin point on March 22, 1914, on an ice-exploring expedition over Beaufort sea. The three men of the support party returned to land at Kamarkak, about 30 miles west of Herschel island on April 16, bringing the news that Mr. Stefansson and his two sailor companions, Storker Storkerson and Ole Andreasen, were going ahead fifteen days more travel before attempting to return, with the possibility of trying to push across the ice to Banks island in case conditions were favourable. As there were a much greater number of vessels and people than usual located at frequent intervals along the coast from Herschel island to point Barrow that season, the party would have been soon heard from if they had returned to the mainland in the spring or summer. As no further news was heard from the ice party, it was evident from knowledge of their plans that they had gone on towards Banks island.

The schooner *Mary Sachs*, under command of Mr. George H. Wilkins, with a full equipment of provisions, distillate, oil, etc., for two years or more, sledges, dogs, and a large gasolene launch, started from Herschel island for Banks island on August 11, and as we learned in the following spring, had met Mr. Stefansson's party near cape Kellett early in September, very soon after the vessel reached Banks island. Of course no word of this could reach the outside world until over a year later, causing considerable anxiety, as the three men of the ice party were generally supposed to have been lost for a year and a half. Having connected with the vessel with its supplies and exploring equipment, the activities of the Northern party during the remainder of 1914-15 were engaged in operations in the region of Banks island, Prince Patrick island, and Melville island. Advices received in the summer of 1916 indicated that the party was intending to remain in the north for at least another year. The *Mary Sachs* was still at cape Kellett, the *North Star* had joined the Northern party in 1915 and was hauled up on the northwest coast of Banks island, and the *Polar Bear*, a large schooner which was purchased in 1915, was wintering near the Princess Royal islands, in Prince of Wales strait, with the intention of moving on to Winter harbour, Melville island, for the winter of 1916-17.

While at Herschel island in August, 1914, we learned from SS. *Herman* of San Francisco, of Capt. Robert Bartlett's remarkable ice-journey from Wrangell island to Siberia, and his safe arrival at St. Michael's, Alaska, to bring relief for the shipwrecked *Karluk* survivors on Wrangell island, but it was not until November 9, 1915, that we got any more news from the outside world, and learned of the loss of eight members of the *Karluk* party on the ice, and the death of three more on Wrangell island, at the same time that we learned of the great European war, which had been going on for over fifteen months.

The schooners *Alaska* and *North Star* sailed east from Herschel island, August, 17, 1914, and were delayed a little by heavy ice in Mackenzie bay between Herschel island and Shingle point. Very little ice was found east of Shingle point, on the western edge of the Mackenzie delta, and we reached Baillie island August 21, finding that the *Mary Sachs* had gone on from there towards Banks island. Leaving Baillie island at noon of August 22, we anchored in Bernard harbour, Dolphin and Union strait, in the evening of August 24, and the *North Star* arrived on August 25. We had smooth sailing on summer seas east of Baillie island, free from ice except for a little loose bay-ice in Dolphin and Union strait.

At Baillie island we had met the little gasolene schooner *Teddy Bear*, going out under sail after spending five years in the Arctic. This vessel, which I had formerly met in Coronation gulf in 1911, was the first pioneer trading vessel to come in east of cape Parry. The *Teddy Bear* was commanded, engineered, and sailed by a young French-Canadian named Joseph F. Bernard, a native of Tignish, P.E.I., who had sailed from Nome in 1909 with one white companion to search for new fields for trapping and trading. His companion had been frozen

to death the first winter near Barter island, Alaska, and in 1910 Captain Bernard had gone on alone with a few Eskimos for crew and wintered a little east of the mouth of the Coppermine river. The next year he came out as far as the civilized Eskimo village at cape Bathurst, where he wintered. Without going home, he turned east again in 1912 and spent one winter in a harbour on the south side of Dolphin and Union strait, about sixteen miles south of Liston and Sutton islands, and a little west of Chantry island; the next winter in Lady Richardson bay, southwestern Victoria island, coming out in 1914 after voyaging for five years. His harbour in Dolphin and Union strait, being the first good harbour for nearly 200 miles east of Pierce point, was used as a base station for two years, 1914-16, by the Southern party of the Canadian Arctic Expedition and named by us Bernard harbour, partly in honour of Captain Bernard's pioneer energy in discovering its suitability and using it as a ship station and in recognition of his unusual kindness and rectitude as a pioneer of trade in an uncivilized and unexploited land.

Bernard harbour was chosen by us for its strategic advantages for working the coast both to the west (from cape Parry) and to the east (into Coronation gulf), as well as its nearness to Victoria island (about 35 miles north across the strait). It was about as far east as driftwood could be found in reasonable amounts for fuel.

After discharging the cargoes of the *Alaska* and the *North Star*, and replacing a broken propeller on the *Alaska*, I finally started west with *Alaska* again on September 6, with the intention of getting some driftwood timber from farther west, as well as some more coal from our cache at Baillie island. The members of the scientific staff, with Mr. Chipman in charge, were left at Bernard harbour, to put up winter quarters, with some Eskimo assistants. Capt. D. Sweeney, Mr. D. W. Blue, engineer, Mr. A. Castel, J. Sullivan, cook; Mike, the Eskimo assistant engineer, and Ikey Bolt, a point Hope Eskimo sailor, went west with me on the *Alaska*. Finding weather conditions very favourable at Baillie island, and no ice reported to the westward, it seemed well to go on to Herschel island, to bring on additional coal and oil, and additional supplies which had been expected to arrive from the westward during the summer. The *Alaska* reached Herschel island again September 11. The *Ruby*, which was expected with supplies from the west, had not arrived, and after loading some stores from our reserve stock at Herschel island, on the *Alaska*, we started east again on the morning of September 13.

The *Alaska* came back to Baillie island on the night of September 15, in the midst of a northwest gale, with frequent snow-squalls, and spray freezing on the decks and rigging. The storm kept rising for the next two days, the worst storm of the season, and did not abate until noon of September 19. There was a very high storm tide, rising about 4 or 5 feet at Baillie island, the waters of Liverpool bay seeming to have been piled up by the northwest gale and forced out between the Baillie islands and the mainland. The distillate drums and coal sacks which had been landed on the beach in the summer were half buried by the sand washed up, and we had to dig them out. Quantities of large ice had come in from the northwest during the big storm, but we tried to go out on the morning of September 20.

In trying to turn around in our narrow anchorage, the bow of the *Alaska* ran slightly in the mud. We tried to kedge her off, but with the falling of the westerly wind, the storm tide fell rapidly, and we were soon settled hard aground. The whole cargo had to be discharged and the schooner finally floated free again on the evening of September 24. As the nights were getting very dark at this season of the year with the moon gone, and considerable heavy ice was coming in from the northward, with young ice forming thick and slushy at times, it was a precarious matter to sail at night with a small vessel. In the summer time, with daylight all night, a vessel can tie up to the ice, but it is a different matter

in the autumn when the ice is moving in the dark. From the outlook at Baillie island, with at least three days more delay loading ship from the beach in a dory, it seemed doubtful that we could get east of cape Parry, or possibly Pierce point, and there are no harbours beyond that nearer than Bernard harbour. As we did not have much to bring back to Bernard harbour, and nothing that was absolutely necessary, the advantage in getting back there with the *Alaska* did not seem commensurate with the risk involved to the vessel, so I decided to put the boat into winter quarters at Baillie island, or rather into the harbour behind the end of the Cape Bathurst sandspit. The *Alaska* had to go to Herschel island the next summer (1915) anyhow for supplies and mail, and had a better chance of getting out early from Baillie island than from farther east. The scientific staff, with their supplies and equipment, and the *North Star* were already favourably located at their desired base, and I knew that I could join them by sledge as soon as ice travelling was good. There was a fair amount of supplies on the *Alaska* for the men who were to remain as ship-keepers during the winter. Two fresh whale carcasses on the beach near the ship provided an abundance of dog-food and also attracted a number of polar bears and multitudes of white foxes to the vicinity. Fifteen polar bears were killed by the men on the *Alaska* before I started east on November 20, the skins kept for specimens and the meat frozen and stored away. A number of seals and ducks were killed in the autumn, and seals were killed frequently during the winter.

On November 20, 1914, I started to go from the *Alaska* at cape Bathurst to the winter base of the Southern party on Dolphin and Union strait, an approximate distance of about 400 miles, accompanied by Aarnout Castel (sailing master of the *North Star*), James Sullivan (cook of the *Alaska*), and the Eskimo, Ikey Bolt taking one Nome sled and seven dogs. We followed the west side of Franklin bay 90 miles to Langton bay. The only inhabitants on the shores of Franklin bay that winter were two families of Mackenzie Eskimos who had taken a small schooner belonging to the Hudson's Bay Company from the Mackenzie river, to the mouth of Horton river, where they were wintering. This vessel went back to the Mackenzie, the following summer. The sailing schooner *Rosie H.*, which has been permanently in the Arctic for many years, was wintering at Booth island (cape Parry) with one white man and several Herschel island people. We did not go around cape Parry, but shortened our distance considerably by crossing the portage at the south end of the Parry peninsula, from Langton bay to Darnley bay. The yawl *Argo* came in from northern Alaska with two white trappers and their families, to the southwest corner of Darnley bay in 1913 and remained until 1915. On the southeast side of Darnley bay we passed the house of Capt. Christian Klengenberg, an ex-whaler with his family, and another house belonging to an Eskimo family which had come in from Alaska on the *Argo*. Klengenberg's young son and daughter had a temporary trapping camp a little east of cape Lyon, and east of that there were no inhabitants west of Dolphin and Union strait. East of Baillie island there are no permanent residents, and the western Eskimos make only casual excursions into the territory.

The *North Star* had made a cache of provisions and coal oil at Pierce point in the fall, and we took some supplies from it on this trip. We did not know whether we should find driftwood enough for fuel at all points along the coast on the 200 miles between Pierce point and Bernard harbour, and expected to use a "Primus" coal oil stove part of the time. However, we found enough driftwood, for fuel at every camp site along the coast, and put up piles of wood at various points so that there would be no danger of having the wood covered with heavy ice before we should pass along the coast in the spring. On December 10, behind Keat's point, we met Kenneth G. Chipman and John J. O'Neill with a sled. They had left Bernard harbour November 19, to make a preliminary topographical and geological reconnaissance as far west as Pierce point, in preparation for the coming spring's work, as well as to look for the whereabouts of the

Alaska. They had found the weather very unfavourable for survey work, being foggy earlier in the season, and storms and blizzards prevailing later. They had been held in camp for six days straight when we met them, with strong head wind and blizzard, while we had been able to travel part of the time with fair wind, which makes a tremendous difference. They turned around and accompanied us to the eastward. We found open water pretty close to the shore all along from cape Lyon to Clifton point, and at Deas Thompson point the ice had recently broken away from the cliffs and we had to make a detour around over the hills. We were delayed two days by a blizzard near Wise point, and reached the winter quarters of the main party about noon, December 25. Travel had been rather slow, principally on account of the shortness of the days at that time of the year, between 69° and 70° North. It was barely light enough to see a trail at 9 a.m., and it was dark about 3 p.m. on clear days, while the period of daylight was considerably shorter on cloudy and foggy days. The temperature in general was warmer than usual at that season, not going below zero Fahrenheit at any time of observation during the first two weeks of December, 1914, and an occasion rising to 25° above zero Fahrenheit. Before leaving Baillie island we had a cold snap, the thermometer reaching 31° below zero on November 7. Coming east from cape Lyon the prevailing wind was favourable, from the northwest. The freeze-up in 1914 occurred at cape Bathurst about September 30, and at Bernard harbour about October 16.

Everything was in good shape at Bernard harbour, the winter quarters of the most of the Southern party. A frame house had been built, covered partially with boards and partially with canvas, and the whole sodded over in the autumn. Enough small driftwood had been picked up in autumn to last for fuel until Christmas, and more was hauled later in the winter, and pieced out by a sparing use of coal. East of cape Bexley there is very little large driftwood on the beaches, on the points around Cockburn point, east of cape Bexley, there is quite a quantity of small pieces of wood, and quite a bit on Chantry island, but very little east of Chantry island of any kind.

About thirty seals had been killed at Bernard harbour in the autumn, by shooting at the edge of the ice in the western method, but only four caribou were killed. The great herds of caribou which usually cross the strait near this point from Victoria island to the mainland, did not pass near Bernard harbour in 1914. The Victoria island Eskimos who visited the station later, said that the reason the caribou did not cross here this autumn was on account of the late freezing of Dolphin and Union strait. The caribou came down in large numbers to the south coast of Victoria island north of here, and as the strait was not frozen so that they could cross over, they moved eastward along the south coast of Victoria island and crossed some distance to the eastward. The Eskimos on the Victoria island side north and east of Bernard harbour killed large numbers of the caribou in the autumn, and we were able to purchase all the frozen caribou meat we needed as soon as the Eskimos could haul it across, and later, after the Eskimos' winter sealing, by spearing through the ice, had commenced, we were able to buy all the fresh seal meat we needed for dog-food or table use.

During February and March, 1915, Mr. Aarnout Castel and myself made a toboggan trip from Bernard harbour across the west end of Coronation gulf, up the Coppermine river, to Dismal lake, and across to the Dease river, northeast of Great Bear lake. We were much delayed by soft snow amongst rough, jagged ice on the Coppermine, and our dogs were too exhausted to be able to proceed very far through the very deep, soft snow on Dease river, so we had to turn back to the coast without making connections with any white man or Indians on Great Bear lake to take out our winter's mail. We reached Bernard harbour again April 1, and a little later the mail was sent out along the coast to the *Alaska* at Baillie island.

On the Coppermine river, around Dismal lake, on the Horton river (south of Franklin bay), and to a less extent farther west, we have often noted the large proportion of dead spruce trees near the northern limit of timber. In some areas about 90 per cent of the trees are dead, in districts which show little or no evidence of forest fires. Mr. F. Johansen and Mr. D. Jenness accompanied our inland trip as far as the edge of the timber-line on the Coppermine, near the Sandstone rapid. Mr. Johansen made a careful study of forest conditions here and found that practically all the dead trees which were examined showed traces of the ravages of bark-beetles, three species of them being found. This knowledge may be of value to northern forestry.

The programme for the spring's work had been planned before going inland. Mr. John R. Cox, with an assistant, started in March and made a careful survey of the coast along the south side of Dolphin and Union strait from Chantry island east to cape Krusenstern and as far south as Lockyer point. Starting again in April, he carried the survey around the west end of Coronation gulf, including Basil Hall bay and the north side of Back inlet, as far as the mouth of Rae river. Rae river was ascended and carefully surveyed for about 70 miles, until it forked into two small creeks. Large willows were found at rather frequent intervals on Rae river after getting some way from the coast, but no spruce or other timber. After reaching the head of Rae river, Mr. Cox's party made a six-day portage across country with their sled, striking the Arctic coast on the south side of Stapylton bay. Numbers of caribou were seen migrating steadily northward during their work on the Rae river and the trip to the coast, and they had no difficulty in killing a caribou whenever they needed meat. Mr. Cox then surveyed the section of the coast from Young point (the western end of Stapylton bay) east to the home station, reaching Bernard harbour May 25. He found that South bay, southwest of cape Bexley, was somewhat deeper in extent than we had supposed, and that Stapylton bay is not as deep as the existing charts make it appear. The rock exposures on Rae river were the prevailing dolomite and limestone of the region, with diabase near the mouth of the river. At cape Kendall, a little north of the mouth of the river, high diabase cliffs are found overlying sandy limestones.

Mr. Kenneth G. Chipman and Dr. John J. O'Neill started on the western survey from Bernard harbour on March 17, 1915, going direct to the west end of Darnley bay and working east. Connecting with the previous surveys of the Parry peninsula, the survey was carried east during April, the season being much further advanced than it was farther east during the same period. As there are no rock exposures near the coast near the south side of Darnley bay, Dr. O'Neill was able to remain on the east side of the bay to carry on geological investigations in more detail, while Mr. Chipman completed the topographic work on the southwest part of the bay.

The southern part of Darnley bay had never been surveyed before and only imperfectly explored. Two fairly large rivers flow into the south and southeast sides of the bay, the most southern of which seems to have been visited by Mr. A. J. Stone[1] while on a short trip after muskoxen from the whaling ships which were wintering in Langton bay in 1898, and indicated by him on a rather inaccurate sketch-map as Hornaday river. As the river is approximately identifiable, and has no discoverable local name, it seems proper that the name Hornaday river should be retained for this river, in honour of the well-known advocate of Wild Life Conservation in the United States and Canada. For the southeastern river we propose the name Brock river, in honour of the patriotic and capable geologist, Major R. W. Brock, former Director of the Geological Survey, to whose active interest in Northern geology the organization of the geological and topographical sections of the expedition are largely due. Dr.

[1] Stone, A. J. Some Results of a Natural History Journey to Northern B.C., Alaska, and N.W.T. Bull. Amer. Mus. Nat. Hist., Vol. XIII, vi, New York, 1900, pp. 63–67.

O'Neill ascended this river for some distance, and made a good geological section of the country. Inland on the east side of Darnley bay he found beach gravels and terraces above 500 feet, and everywhere east of that point the country for some distance from the coast is of the same type. From Darnley bay to the east of Deas Thompson point there are a number of high points which have received the name of mountains, but no definite system of range is apparent. The highest of these points (Mount Davy) is between the Croker and Inman rivers. The coast has a well-defined shore-line of rock or boulders and gravel.[1] None of the rivers flowing to the coast east of Darnley bay extend any great distance inland, for their valleys are small, and both valleys and beds indicate a very heavy run-off in a short time. The Croker is the largest river, with its delta built out a short distance, and occupies a triangular valley some 4 miles wide at the coast, and extending inland for 3 or 4 miles. The river spreads out over its delta, and none of its channels are very definite. The beds of this and other rivers are composed of heavy boulders, and the quick run-off is further indicated by the continuous sandbars built across their mouths when the river is low in summer and fall.[2]

The coast-line as traversed from cape Lyon eastward was found to be somewhat more straight than the former charts give it, but this is apparently due to the practical impossibility of sketching a coast-line accurately on a hurried boat-passage some distance off-shore, with infrequent landings. This method has given the result that many of the so-called points on this coast are not salient projections of the coast line. More often the charted points and capes are high land or rock cliffs with low land on either side. This gives the higher places the appearance of points or capes when viewed from a distance. Our method of locating control points at frequent intervals by latitude, longitude, and azimuth observations, traversing between these points by frequent compass sights and pacing all the intervening shore-line, will undoubtedly give a more accurate map, although the former maps of this section of the coast are really very good considering the conditions under which they were made. No serious rectification was necessary until we came to Stapylton bay and eastward of that point. Mr. Chipman regards the whole country surveyed as evidently a portion of the coastal plain described by Tyrrell,[3] which west of Hudson bay reaches an elevation of 500 to 600 feet, and varies in width from 75 to 300 miles. Numerous fossil shells are found along the old beach terraces. West of Chantry island fossils were collected from the 15-foot and 30-foot horizons. These fossils may be duplicated on the present strand-line. Near the mouth of Inman river, fossil shells were found in numbers up to 170 feet above sea-level.

Dr. O'Neill reports the country rock,[4] at least as far west as Clifton point, as a light grey to buff-coloured dolomite, sometimes with interbedded grey chert, and frequently containing fragments and nodules of the same. Ripple-marking and what seems to be mud-cracks were seen in some layers. A concretionary structure is quite common. The beds vary in thickness from a fraction of an inch to a few feet, and in grain from very fine to quite coarse and crystalline. They have a dip of about 10 degrees, a few degrees north of west. About 15 miles east of De Witt Clinton point there is a cliff of conglomerate 40 feet in height with an 8-foot capping of sandstone. The conglomerate is made up almost entirely of pebbles of quartzite and chert, and has a few small seams of buff-coloured sandstone interbedded with it. The overlying sandstone is coarse-

[1] Chipman, K.G. Summary Report of Geol. Survey, Dept. of Mines, for the year 1915. Ottawa, 1916, p. 245.

[2] Summary Report of the Geol. Survey, Dept. of Mines, for the calendar year 1915. Ottawa, 1916, p. 245.

[3] Tyrrell, J. B. Report of the Doobaunt, Kazan and Ferguson rivers, vol. 9, p. 158.

[4] Summary Report of the Geol. Survey, Dept. of Mines, for the calendar year 1915. Ottawa, 1916, pp. 239–241.

grained and weathers reddish-brown. About DeWitt Clinton point there are cliffs of very dark grey limestone 40 to 50 feet high, with beds 3 or 4 feet thick, and with a few thin beds of light grey limestone. At one place fine-grained diabase cuts through the limestone and spreads out as a capping on the cliff. The hills about here are covered with a mantle of alluvium, resembling glacial morainic material, which weathers to a buff colour on the surface. It is at least 30 feet in thickness. About Deas Thompson point there are cliffs of limestone 30 feet in height, dark-coloured at the base and lighter grey above, thin-bedded, and with encrustations of gypsum along seams and in fissures. Keats point is made up of coarse, reddish-coloured sandy dolomite. There are two distinct sets of glacial striae in the vicinity of Chantry island, one set running east and west (true), and the younger set running north 77 degrees east (true).

In an examination of the rocks from the foot of Darnley bay to cape Krusenstern, no evidence of the existence of copper was seen. A series of sediments is intruded by sills, or sheets of diabase at intervals from 20 miles south of cape Lyon to DeWitt Clinton point; no diabase is then seen again until one nears cape Kendall on the west side of Coronation gulf; north of Back inlet.

After returning from the inland trip up the Coppermine, I started west from Bernard harbour April 21 to reinforce the western survey party, meeting Chipman and O'Neill coming east near Deas Thompson point on Amundsen gulf. The Eskimos, Ikey and Palaiyak, who were with the party, were sent on to Baillie island with the mail, and to help on the *Alaska*, while I returned eastward again with the survey party. Owing to the extremely short-handed condition in which the Southern party was situated and the large amount of work planned for the coming summer, it was impracticable for me to return to Baillie island and return to Herschel island again with the *Alaska*, as I had intended. Instructions were forwarded to Capt. Daniel Sweeney of the *Alaska* at Baillie island, and he carried out the summer's work of the vessel very creditably and carefully, bringing in the mail, and a good load of additional provisions and coal from Herschel island The ice left the beach at Baillie island, at 5 a.m., July 10, 1915, according to Captain Sweeney's report, and the *Alaska* got out of the harbour at 9 p.m., reaching Herschel island July 13. The first vessel to reach Herschel island from the outside was the *Polar Bear*, which arrived August 3; the *Ruby*, which brought in stores for the Canadian Arctic Expedition arrived August 14. The *Alaska* was loaded and left Herschel island to go east again August 22, reached Baillie island in the evening of August 23, left Baillie island in company with the missionary boat *Atkoon* of Collingwood, and the schooner *El Sueno*, arriving at Bernard harbour September 5, 1915. The *El Sueno* arrived September 7, bringing in a small amount of auxiliary supplies for the Southern party, and at once went west again to winter at Pierce point, for the purpose of trapping. The *Atkoon* was blown up on the shore between Clifton Point and the mouth of Croker river, but the vessel was apparently uninjured, and the missionaries established a winter camp there.

Our western survey party reached the station at Bernard harbour on May 24, 1915, one week ahead of our scheduled time. We had decided upon the date June 1 as the time for the sledge-survey parties to be back at the station, to avoid being troubled by the breaking out of the rivers. The unusually mild weather during the month of May facilitated our work very much. The skies were usually clear, and conditions good for travelling and taking observations. The weather was very warm and the snow thawing fast around Croker river May 16, but east of that point the season was more backward, and at Bernard harbour the ground was completely snow-covered until after the first of June. The snowfall is not very deep in this region, however, and after the snow really starts melting, it practically disappears from the land within a very few days, except the remains of deep snowdrifts in gullies and on the shady side of hills.

From the experience of the topographers of the Southern party of the expedition this spring, and in the year preceding and the year following, it was found that very little accurate topographical surveying on the lines laid down for us, 10 miles to the inch, with control stations at frequent intervals, could be done before the middle of March at the latitude we were working (from 67° 30′ to 70° approximately). Some compass lines could be run before that time, where salient points were already located, but earlier than the middle of March the sun is too near the horizon to get satisfactory observations, on account of the great refraction near the horizon. Blizzards and clouded skies were so frequent early in the spring that calculated occulations of stars and planetary satellites could only rarely be observed at a stationary observatory, and such observations were of little use in field work, and by the latter part of March the daylight period was so nearly continuous that there was no opportunity for other than solar observations after that season.

On May 21, 1915, Mr. George H. Wilkins arrived at Bernard harbour, accompanied by James R. Crawford, discharged as engineer of the Northern party's schooner *Mary Sachs*, and one Eskimo, named Billy Natkusiak. They had come from the winter quarters of the *Mary Sachs* near cape Kellett, Banks island, making the trip in about twenty-five days, across the southern end of Banks island, Prince of Wales strait, Prince Albert sound, and Dolphin and Union strait. Mr. Wilkins had found the Stefansson party safe near cape Kellett the summer before, and had come to make some arrangements to take the *North Star* to Banks island or Prince Patrick island as an auxiliary for further advanced party for proposed more extended work of the Northern party. The plans for the work of the Southern party had been based on the certainty of having the *North Star* for the summer's work in Coronation gulf, as the *Alaska* was at Baillie island, and bound to go to Herschel island before coming in again. It was finally arranged that the *North Star* should first lay down some provision depots in Coronation gulf and take the gasolene launch and outfit as far east as cape Barrow, and then go west to Herschel island, and later to Banks island.

Mr. Wilkins had lost his cinematograph outfit on the *Karluk*, but had obtained another cinematograph camera and a few thousand feet of film from the engineer of the wrecked schooner *Elvira* in 1914. He made a short trip on the ice of Coronation gulf and secured studies of Eskimo life in camps on the ice, and later in the season, views of their summer camps, fishing scenes, and home life and habits. About 2,000 feet of cinematograph film was exposed, most of which was ultimately developed and found to be of good quality. Mr. Wilkins made a very good series of portrait studies of most of the local Eskimos (Dolphin and Union strait), men, women, and children, in full view and in profile, for Mr. Jenness's ethnological work. He also made good photographs of growing plants, insects, etc., for the botanist and entomologist, and many photographs of birds, mammals, etc., in their natural habitat; pictures of great scientific as well as artistic value.

The expedition had always prided itself on being thoroughly prepared and equipped to take the field and work at any season and under any conditions. These problems of equipment may be roughly covered under four heads: (*a*) Winter and early spring sledging with tent or snow-house, using either wood, alcohol, Primus coal-oil stove, or native blubber-lamp; (*b*) late spring and early summer, prepared for either land or water travel; (*c*) summer travel with boat or canoe; and (*d*) overland packing by men and dogs in summer.

The western survey parties having finished their work late in May, it became necessary to start early summer work at once to the eastward. In Coronation gulf the ice was still solid in June, but there was the possibility of cracks and leads to cross as the season advanced, and boat-work after the break-up of the ice. The Northern party of the expedition had made good use of waterproof tarpaulins in constructing sled-rafts to cross leads, being

unable to haul canoes over rough ice, but of course this made no provision for travel after the break-up of the ice. Our problems were somewhat different, as in Coronation gulf the ice was comparatively smooth. We took a large point Barrow whaling umiak, about 28.15 feet in length, and 6 feet beam, covered with heavy bearded-seal skins, and strengthened the stern timbers to provide for the adjustment of an Evinrude detachable gasolene motor, which proved to be a very valuable auxiliary. The canoe could be lifted by two men and placed on a low, ivory-shod boat-sled, which could be hauled in the spring by four or five dogs, carrying several hundred pounds of baggage inside of the boat. If necessary to cross a lead, the umiak could be unshipped and launched in a few minutes, and if the ice should break, the canoe would be launched automatically, already loaded. Later in the season, the umiak proved its worth by carrying two or three men, three dogs, and a thousand pounds or more of provisions, gasolene, and camp gear, making 5 to 6 miles per hour, and weathering some pretty heavy seas. It could be beached on any kind of coast in a hurry, by rolling it up on inflated sealskin " pokes," a great advantage when exploring a coast whose harbours are unknown, and a sudden breeze speedily raises a dangerous lop, as it does in Coronation gulf. The umiak is also a very useful boat among ice-floes, as it is practically unstovable and can be easily and quickly hauled upon or over an ice-cake, and it will also stand bumping over the boulders on a river-bottom which might prove disastrous to a wooden boat. The weight of a wooden boat of sufficient size would also be an insuperable obstacle to transportation by sled. For inland work in the Coronation gulf region, recourse must be had to packing in the summer, as most of the streams are too small and rapid to be navigable for any distance. The survey parties were supplied with condensed rations, and had dog pack-saddles for their largest and strongest dogs. Three or four good dogs can pack all the necessary provisions for a small party for several days.

On June 9, 1915, John R. Cox, topographer, and J. J. O'Neill, geologist, started eastward from Bernard harbour with the umiak on a boat-sled, taking also another large sled-load of provisions, supplies, and gasolene. They had as assistant for the early summer an intelligent Alaskan Eskimo, Billy Natkusiak, who had been with me in the region several years before, and also as an experiment, a family of Coppermine Eskimos (a man named Mupfa, with a wife and child). We had heretofore little success in getting any useful service from the local aborigines, who have little or no idea of serving or working for anyone. It seemed necessary, however, to engage somebody to look after the sledge dogs, or part of them, after the surveying party should have to take to boat work, and this native engaged to help in the spring and look after our dogs during the summer at a fishing-place on one of the rivers on the south side of Coronation gulf. The man Mupfa turned out to be a very capable, intelligent man, and willing to learn, and carried out his agreement for the summer very creditably, and rendered loyal service to the expedition for the remainder of the next year. The party was to proceed by sled to Tree river, or the Annielik (in Gray's bay); during the early summer to work geologically up some of the rivers in that region, moving gradually along the coast to cape Barrow, 68° 01′ N., 110° 09′ W., the western extremity of Bathurst inlet, where Mr. Chipman and I would meet them with the *North Star* about the first of August, if possible, bringing the gasolene launch and additional supplies.

At cape Barrow, the circumstances of the season and the condition in which we found the party and the boats at that time, would determine the extent of the survey which we could make of Bathurst inlet during the latter part of the summer. It was planned to finish up as much as possible of the eastern end of our assigned territory during the summer of 1915, leaving the region nearer home (around the mouth of the Coppermine river) for the early autumn or coming spring, when the unfinished ends could be worked to better advantage

from the base station. During the early summer of 1915, Mr. K. G. Chipman began a stadimeter survey of the region about Bernard harbour, with 20-foot contours. Mr. F. Johansen did some dredging for marine life in the inner and outer harbours, and completed his collections of the plants and insects of the region, while my own collections of birds and mammals was considerably increased. Considerable quantities of salmon trout were sun dried for winter dog-food, and some caribou meat was also dried for our own consumption. The few families of Eskimos who remained about during the early summer caught and dried large numbers of lake trout, catching them with hooks through the ice in June and early in July, and spearing and gaffing large numbers of salmon trout which were impounded in stone weirs when they started to run up the streams in July. By the last of July all the local Eskimos had departed on their summer packing expeditions to look for caribou inland.

The summer of 1915 was very late and cold, and the ice melted very slowly. The *North Star* had started to leak badly during the winter, and we finally succeeded in getting the vessel free from the ice and hauled up on top of the ice in the harbour July 7, and caulked her thoroughly. A few days later the ice had melted enough to drop the vessel into the water again, and on July 20 all the ice was out of the harbour. Bay ice disappears with wonderful rapidity at that season, the hot sunshine cutting away the top almost visibly, the ice floating up as it melts, and when it finally disintegrates into small pieces which touch the water on all sides, soon disappears absolutely. After the harbour and the large bay south of Chantry island were free of ice, Dolphin and Union strait was pretty full of ice. Broad leads opened up outside for a little, but the ice seemed pretty solid to the eastward. A steady, strong northwest wind for a week, practically a gale for three or four days, kept driving the ice down into and blocking up Dolphin and Union strait, and in the early part of August, between Bernard harbour and the Liston and Sutton islands, the strait was packed full of rough, heaped-up blocks of ice, where we had only smooth bay ice all the previous winter.

After being held for nearly two weeks after the break-up of the ice by heavy ice packed into Dolphin and Union strait by continued westerly winds, a spell of easterly wind started the ice moving westward again, and we worked the *North Star* out through the ice east of Chantry island August 9, finding the ice slowly moving westward. We were unable to get by the south side of Lambert island after going about half-way, finding the south side of the strait pretty well packed with ice, and went back around the west end of Lambert island to the north side of the island, passing over some dangerous rocky shoals extending for some distance off the west end of Lambert island, 6 feet of water 400 to 500 yards off shore. There is also a series of rocky islands and reefs off the east end of Lambert island. We passed cape Krusenstern in the evening of August 10, and passed through the Duke of York archipelago during the night, finding very little ice after passing cape Krusenstern, and Coronation gulf entirely free of ice to the eastward. We reached port Epworth, the splendid harbour at the mouth of Tree river, 67° 46′ N., 111° 59′ W., and found a large stone beacon on the island at the mouth of the harbour, with a cache and a note signed by J. J. O'Neill and J. R. Cox stating that they had been working in that region until July 30, when the ice moved off the coast allowing them to proceed eastward. They had gone on east to cape Barrow, where we found another beacon on August 12, stating that they had reached that point August 2. They had been delayed by head winds, and we soon found the party camped in a little bay just east of cape Barrow. The *North Star* put down a large cache of provisions at port Epworth, consisting of flour, rice, pemmican, sugar, and gasolene for the two motor-boats; and another cache at cape Barrow for use during the summer of 1915 and the possibility of sledge work in the spring of 1916. The *North Star* at once started back to the westward, on August 12,

having been delayed only three days after getting out of the harbour in making the eastern trip. Having a stiff fair breeze behind her, the *North Star* was back at Bernard harbour within twenty-four hours, and finding all the ice had moved to the westward, kept on going and soon reached Baillie island. The party who went west on the *North Star* consisted of George H. Wilkins, commanding; A. Castel; James R. Crawford (discharged at Baillie island to go out on schooner *Ruby*); and the Eskimo, Billy Natkusiak. The party remaining at cape Barrow consisted of four men, K. G. Chipman, J. R. Cox, J. J. O'Neill, and myself, with one 20-foot wooden gasolene launch with 7-horsepower Gray motor, and the skin-umiak with Evinrude motor.

Cox and O'Neill, with their Eskimo assistants, had left Barnard harbour June 9, hauling the skin umiak on a boat sled, and crossed Coronation gulf direct from cape Krusenstern to the mouth of the Tree river (port Epworth), being delayed by only one large crack in the ice, about 30 feet wide. The season was much further advanced around Tree river than it was at Bernard harbour and the ice was soon cut away around the mouth of the river. Large quantities of fish were caught after the opening of the bay, and in addition to what were used by the party and their large bunch of dogs, over 500 pounds of fish were dried, baled and put *en cache* on the island at the mouth of the harbour for autumn use. Wolverines are surprisingly abundant on the coast in this region, and unless provisions and stores are cached on islands they are apt to suffer from the ravages of these brutes during the summer. Tree river was explored for some distance inland on a packing expedition in July. Like all the other streams in this region (in the granite area) it has rapids, cascades, and falls a few miles from its mouth. It abounds in fish in the summer-time, and several families of Eskimos usually spend the summer at the first cascade, catching fish by spear, hook, and raking with a sort of double gaff-hook. Salmon trout and two species of white-fish are largely caught in the rivers, while large lake trout are caught in nearly every lake of any size. The country a little back from the mouth of Tree river is dotted with innumerable clear lakes, basins in the granite, and the vegetation, particularly in the flowering plants, is richer than the average condition in the Arctic. A good collection of plants was made here during the early summer. Tree river has two large branches, one of which is said to rise near the east bank of the Coppermine. This western branch of Tree river is said to have spruce trees near its source. The scenery around port Epworth is quite striking, vertical cliffs of dark-coloured diabase, with long talus slopes, rising to a height of 600 feet above sea-level on either side of the harbour. A long ridge of dolomite runs west from the mouth of the river, about five miles back from the island at the entrance of the harbour of port Epworth. The island at the entrance of the harbour is black shale at the base, overlain with diabase. About five miles south of the mouth of Tree river a ridge of rounded granite mountains runs to the south and east side of the river, the highest peak noticeable, about ten miles back from the entrance of the harbour, being 1,090 feet above sea-level. It is interesting to note that about half a mile east of the mouth of Tree river, there are small crevices or pockets in the granite which are filled with the soft potstone (a talc chlorite schist), much used by the Eskimos of this region for making the stone blubber-lamps which are universally used by them, and also for making stone cooking pots. The use of the cumbersome, heavy, and fragile stone pots, however, is very rapidly declining, owing to the much greater convenience of tin, iron, and copper-ware which are being introduced in trade. There is no known potstone quarry west of Tree river, and most of the stone utensils come from there although the Eskimos informed us that there are also some smaller stone deposits on the Utkusikaluk, flowing into Gray bay, and somewhere around cape Barrow

According to Dr. O'Neill,[1] the islands in Coronation gulf, on a line southeast from cape Krusenstern to port Epworth, are all of diabase; no amygdaloid was seen, but some of the islands are cut by narrow veins of calcite which contain small patches of chalcocite. While making a second trip through these islands in May, 1916, I was impressed by the rugged formation of these islands, including many of the islands of the Duke of York archipelago. The group known to the Eskimos as Pauneyaktok, about 20 miles southeast from cape Krusenstern, are typical of the group, having precipitous cliffs of diabase running up to 200 feet in height, facing to the south and southeast, and sloping down to the water's edge on the north and northwest sides. Underneath the diabase of one of these islands, I noticed an exposure of sedimentary rock, a series of alternate layers of black and reddish strata about one inch thick, merging into a tick, flesh-coloured stratum. The base of the islands is very seldom visible, being hidden by talus slopes from 10 to 40 feet high.

" The coast from port Epworth to Grey's bay is diabase cutting grey shale or red sandstone, which immediately underlies the shale; no amygdaloid nor copper is in evidence in this diabase, of which the upper part has been removed by erosion. The Laurentian granite comes to within 3 miles of the coast at the Kogluktualuk or Tree river, and its western contact with younger sediments extends almost true south for over 30 miles. The northern border of this granite parallels the coast to the west end of Gray's bay; it forms the southern shore of Gray's bay and the whole coast from that place to the east side of cape Barrow."—(O'Neill.)

Cape Barrow, 68° 01′ N., 110° 09′ W., or Han-in-nek, as it is called by the Eskimos, is a mountainous granitic region, but is not nearly so high as stated by Franklin in 1821[2]. He says: " The higher parts attain an elevation of 1,400 and 1,500 feet and the whole is entirely destitute of vegetation."

In 1915 we found the height of the highest of the granite ridges to be 340 feet above the sea-level, by aneroid, and although the hills have a barren appearance on their summits and slopes, careful inspection shows many bright green patches in little valleys and gullies where soil has collected, as well as in basins in the rocks, around the little lakes—green grass, low dwarf willow, deep tundra moss, cotton-grass or " nigger-head " tussocks (the *têtes des femmes* of the northern Indians and voyageurs) heather growing luxuriantly in many shelving rocks, and about ten species of flowering plants in bloom close to our camp on August 13. The summits of the granite ridges were usually covered with gray lichens. In this region we were often deceived by great reddish areas on cliffs, giving the appearance of a ferruginous rock, but upon closer examination proving to be only a dense coat of red lichens.

After the return of the *North Star* to the westward, Chipman, Cox, O'Neill, and myself continued the survey east from cape Barrow with the small launch, umiak, and a Peterborough canoe. It turned out that this plan cut down to some extent as originally planned, as we had to lie over a good many days on account of stormy weather and high winds when we could not use the small boats, and might have gone ahead or anchored in more favourable place with the *North Star*. With the small boats we had to find a very small and very well-protected harbour for each night's camp. We were also prevented from getting back to the station before the freeze-up, as the almost continuous heavy weather late in the autumn prevented us from travelling a large part of the time with the small boats. The Evinrude motor did good service in the early part of the season on the umiak, and the two boats were able to work to some extent independently, by having one boat make more prolonged stops at the most

[1] Summary Report of the Geological Survey, Dept. of Mines, for the calendar year 1915. Ottawa, 1916, pp. 241.

[2] Narrative of a Journey to the Shores of the Polar Sea, in the years 1819, 20, 21, and 22. By John Franklin, Captain R.N., F.R.S., and Commander of the Expedition. London, John Murray, Albemarle Street. MDCCXXIII.

interesting points for geological work, while the launch could keep running more or less continuously on the coast traverse. In the latter part of August, the Evinrude motor on the umiak gave out, and as we were not prepared to re-babbitt the bearings, which had been cut out by some grit, we had to lay the umiak up for a while near Kater point, Arctic sound, as it reduced the speed of the launch about a mile per hour to tow the umiak, and the winds were not steady enough to keep up by sailing. With the umiak out of commission, Mr. Chipman found it necessary to stay in the vicinity of Kater point for about three weeks, and this cut down the topographic work considerably.

Previous to this the coast survey had been completed in detail from cape Barrow, around Detention harbour (a rather large bay nearly hidden by a large island nearly hiding the entrance; with a deep channel behind except at one narrow point near the eastern exit, where it narrows to about 100 yards in width and only one fathom of water). An investigation was made of the islands along the coast here and farther south in Moore bay. The islands from Gray's bay east were little granite outliners here and there near the coast, but north of Moore bay, and lying two or three miles outside of the Detention Harbour islands, are some rather large islands, called Nu-a-ho'-ngak by the Eskimos. The latter islands are stratified dolomite, cut by a large dike of diabase, which also runs inland on the mainland here. Moore bay is rather larger than indicated by the charts, with a rather deeper extension to the southeast and a number of high diabase islands. We found our first native copper *in situ* in cracks in the diabase on an island in Moore bay. Small veins of galena (lead sulphide, Pb. S.) were observed in cracks in the granite at Galena point, just east of Detention harbour. There is a river of fair size flowing into the southwestern point of Moore bay.

From Kater point, O'Neill, Cox, and I continued to carry on the survey with the launch down the west side of Arctic sound. Some difficulty was experienced in finding a channel into the mouth of Hood river through a number of low sandy islands at the mouth of the river, on account of a heavy sea running at the time. After entering the river we found a deep channel, 9 or 10 feet deep, following the high-cut bank along the south side of the river for 3 or 4 miles from its mouth. At the first large bend, the channel shifts to the left (west) bank, where there is a small exposure of quartzite at the water's edge, overlain by a thick deposit of light-coloured sandy clay. Willows on the bank here were 5 or 6 feet high, one inch or more in diameter, and quite a bit of dead willow in among them. Considerable willow drift was found on the banks, affording more fuel than was usual in this region. Going up stream from the quartzite bend, the channel gradually swung across to the other bank, but we had no difficulty following the deep channel (over 9 feet) by watching the colour of the water, which was grey over the shoals. We could take the launch up only to the first cascade of the Hood river, and camped there on August 27, making an inland reconnaissance in the direction of the James river. The steep clay banks of the river are about 100 feet high at the first cascade, with a level grassy bench extending back about half a mile to a ridge of fine, red sandstone, cut on the southwest side by a dike of coarse-grained basalt, with a broad grassy valley beyond. The next ridge was quartzite, succeeded by another grassy valley. A herd of thirty-four caribou was found here, and one fat young bull killed to replenish our meat supply. A single lone bull had been seen and killed at Kater point a few days before. A little farther on O'Neill struck an outcrop of granite, pegmatite, and mica schist in the valley, and established the continuity of the granite extending from Detention harbour and Moore bay down to Hood river. Going out of the river again the coast of Arctic sound was followed to its bottom. A fine large specimen of the Barren Ground bear was killed at the

south end of Baillie's cove, the extreme bottom of Arctic sound, where he was found digging roots from the sandy soil near the mouth of a small creek.

The east side of Arctic sound is formed by one side of Banks peninsula (Tikerayuk, or " the forefinger," of the Eskimos), its most northern point being point Wollaston. Native copper was found in amygdules on both sides of Banks peninsula. Running down the east side of Banks peninsula we expected from inspection of the chart to find a passage out through Franklin's so-called Brown's channel,[1] but found that the channel was a blind one, comparatively straight, with another peninsula, shorter than Banks peninsula, on the east side. The southerly portion of this hitherto uncharted sound is fringed for several miles on its west side by high cliffs of grey dolomite. Rather steep slopes of dirt and gravel lead up from the beach in about half a mile to 490 feet elevation. From the top of this slope, nearly vertical cliffs rise to a height of 870 feet above sea-level; composed of heavy strata of dolomite, with a heavy capping of diabase, much striated on the upper surface. Ascending to the top of these cliffs, a small creek was seen to run into the bottom of the sound from a lake about five miles inland, in a broad grassy valley to the southwest. We followed the coast around a series of long, narrow fiords, peninsulas, and small islands east of here, finding the coast line very slow and difficult to work out, being very much cut up in the region tentatively indicated by Franklin as Goulburn island, the latter being really a series of long peninsulas southeast of Banks peninsula. Having struck a considerable copper-bearing area in Bathurst inlet, it was thought better to make a detailed geological sheet of this important area than to attempt to make a complete survey of the bottom of Bathurst inlet outside of the copper area. We accordingly followed the southern boundary of the diabase area across to Kannuyuk (Copper) island, a large island in Bathurst inlet, south of the Barry islands, opposite Fowler bay, on the east side of Bathurst inlet. Driftwood was very scarce east of Kater point, but by picking up every small piece we saw on the beaches, we usually managed to carry enough in the boats to last us a day or two. Bird and animal life was remarkably scarce along the coast. Caribou signs were seen occasionally, and fresh tracks on some of the islands. A very fine large bull caribou was killed on Kannuyuk island, Bathurst inlet, by Mr. Cox on September 3. Numbers of gulls were nesting in rookeries near point Wollaston and on the south side of the Barry islands.

The Barry islands, instead of a single island, are really a group of large islands. The most easterly, called Ekullialuk, the Barry island of Franklin, is properly two large islands, separated by a bay or sound 4½ miles long and 2 or 3 miles wide, running north and south and opening to the north through a deep channel about one-quarter of a mile wide. This bay has several sharp, deep bays indenting its south shore, and several little stony islands near the shore. Cruising along the south side of the big island, along the foot of the precipitous cliffs of diabase, overlying red quartzite, we found an opening into the wall, through a channel about one-quarter of a mile long, one-eighth of a mile wide at the south end and about 100 yards wide at the north end, with a strong tide rip running to the southward when we passed through. In exploring the interior of the bay, we found Sir John Franklin's portage, discovered on his return boat voyage in August, 1821,[2] a passage between walls of almost perpendicular diabase about 100 feet high, but closed by a low, narrow gravelly isthmus about 30 yards across, across which he had to portage his canoes. There are in reality two isthmuses, separated by an " island " of steep rock, the western gravel isthmus being about 100 yards across, and the other narrower. As Franklin did not happen to strike the narrow, open channel about half a mile farther east, he assumed that the whole was a single island. Just northwest of the Ekullialuk

[1] Narrative of Journey to Polar Sea, in 1819–22. By John Franklin, Capt., R.N., etc. London, 1823, p. 375.

[2] Journey to Shores of Polar Sea, in years 1819, 20, 21, and 22, by John Franklin, p. 395.

islands, and separated by another narrow, deep channel is a large island called Adligaq, and north of Adligaq and extending some distance to the northeast of point Wollaston, is the large island called Igloruallig. The northeast tip of this group of islands approaches close to point Everitt on the east side of Bathurst inlet. The region around point Everitt is known as Umingmuktor, and is the centre of a fairly large group of Eskimos called Uminguktogmiut. The Eskimos who frequent the southern and western parts of Bathurst inlet are mostly Kilusiktogmiut, and this region in general is known as Kilusiktok.

As the season was getting advanced, we felt impelled to turn back from Ekullialuk (Barry island), Bathurst inlet, on September 8, 1915, without going to the bottom of Bathurst inlet. The geological results had been encouraging, for two large areas, each of several square miles in extent, were discovered, in which the native copper is widely distributed, and much valuable geological knowledge had been gained in tracing the contact of the basalts with the granites and sedimentaries throughout the region. The plan was made to complete the detailed mapping of the copper-bearing area by sledge the following spring by one party, while another party should fill in the gaps remaining in the coast survey west of Bathurst inlet. We were delayed by heavy weather from the evening of September 9 to the morning of September 14 on Adligaq island. On the 14th we succeeded in running as far as Cheere islands, at the entrance to Arctic sound, where a gale held us until the morning of the 16th, when we succeeded in slipping across to Kater point, where we joined Mr. Chipman. Here we were delayed for eight days, storm-bound in the fine little land-locked harbour. Strong northwesterly winds prevailed, with heavy snowfall and freezing weather. The ground was snow-covered, drifting to 4 or 5 feet in depth in the lee of bluffs and in gullies, while ice on small freshwater ponds was about three inches thick. The temperature of the air during this period ranged from 25° to 31° F., but the sea-water did not get down to freezing during our stay at Kater point, although we were anxiously watching for signs of slush ice. The 24th of September was warmer and quiet, and we succeeded in reaching cape Barrow that evening. Although the weather was otherwise fair, high winds kept us at cape Barrow until September 28. On the night of the 26th, young ice formed for the first time across the little harbour, but about half of it melted or floated out during the day. On the morning of the 28th the launch was run out through about 50 yards of young ice to clear a road to the open water outside. In doing this the ice sawed long holes through both sides of the boat about midships, the boat being only sheathed with tin forward. We were obliged to unload and haul the boat up on the beach high enough to clear the holes, so that we could patch it with tarred canvass and tin. We finally left the harbour at 10.45 a.m. and followed the coast pretty closely to the westward, keeping behind the very numerous small granite islands when possible, and cutting across the mouths of the numerous narrow bays and inlets with which the coast is indented. About 2.30 p.m. we were compelled to stop near the eastern end of Gray's bay, as the wind was too strong to cross the bay ahead. On the 29th we went ahead and entered the mouth of Wentzell (or Utkusikaluk) river a little after 1 p.m. There was a sandbar island at the middle of the entrance of the river and a 4-foot shoal in the channel, but after crossing this the river was 9 or 10 feet deep, with a width of about 100 yards. The coast near the mouth of the river is composed of fine sand mostly, supporting a little grass, wild barley, etc. Small granite outcrops show here and there, and there is a very rugged-looking range of hills two or three miles inland. We stayed only a short time in the river, catching two fine whitefish in a net while we were waiting. The river was rather muddy, but no ice was seen.

At 3.30 the wind moderated a little and we started ahead again, heading for a long point to the westward. The breeze freshening, we soon struck a heavy swell and shipped much spray. Running in towards the low shore, we

struck muddy water about one mile from shore and soon sighted some low sand islands at the mouth of the Kogluktuaryuk river. We tried to enter the eastern channel but grounded, and had to turn back and enter the middle channel. Quite a bit of loose, slushy ice was floating down stream and bunching up along the sides of the river mouth. Numerous fish were jumping out of the water. We found the river frozen completely across about 500 yards upstream. High, steep, black earth or clay banks begin about half a mile from the mouth of the river, running back probably two or three miles to the rocky hills. The roar of large water-falls could be heard from the mouth of the river. As the situation did not look favourable for camping, with no wood and a good prospect of a sudden freeze-up, we ran out of the Kogluktuaryuk, which is about south of the middle of Franklin's Hepburn island (known as Igluhugyuk to the Eskimos), and pushing ahead, camped long after dark on a small island off the mouth of the Annielik river (incorrectly indicated on Hanbury's map[1] as the Unialik). The Annielik river flows into the deep southwest corner of Grays' bay. The muddy water from the Annielik discoloured the waters of the bay for one or two miles from its mouth, and young ice was forming in crystals on the surface of the water in the evening, in calm places in the bay.

Leaving the mouth of the Annielik early in the morning of September 30, we passed the high sandstone cliffs on the west side of Gray's bay and reached a point about 15 miles east of port Epworth at 11 a.m. We were compelled to stop until 3.20 p.m. on account of a stiff breeze springing up, and reached port Epworth harbour, near our cache, about 8 p.m., at which time it was pretty dark. As the freeze-up of Coronation gulf was impending, we decided to stop at Tree river and return to the winter base at Bernard harbour with sleds. Stormy weather followed for four days and the young ice in the harbour was pretty thick on October 6.

We had taken our three best dogs with us on the boats during the summer, for use in packing trips inland and for tracking boats if necessary. Seven dogs and two sleds had been left in charge of some Eskimos at the first rapids about five miles from the mouth of the river, when Cox and O'Neill left this place July 30. We found that the natives had taken good care of our dogs, and the large fish-cache on the harbour island was intact, although wolverines had broken into the rock cache on the mainland and spilled out some flour and rice. Our natives here had just killed a number of fat caribou, and as by frequently dropping a net for fish, shooting caribou, Arctic hares, and other game when needed during the summer, we had been enabled to keep a large stock of reserve provisions on hand, we had no hardship in waiting at Tree river for about three weeks, until the ice of Coronation gulf became strong enough for us to start for home October 27, without following all the indentations of the coast. The Eskimo family which had accompanied Cox and O'Neill to Tree river in June accompanied us back to Bernard harbour. We reached the station November 9, 1915, and on that date received the first mail and news from the outside world that we had received for fifteen months.

Mr. D. Jenness, ethnologist of the Southern party, arrived at Bernard harbour on November 8, 1915, after having been with the Eskimos on Victoria island since April 13, 1915. He had started out with a small band of Eskimos, of whom the chief man, a middle-aged man named Ikpukhuaq, was engaged by Mr. Jenness as a helper. These Eskimos fulfilled all their promises and obligations to Mr. Jenness in a very kindly and creditable manner during the whole time he was with them. They spent most of the summer in the Colville hills in southern Victoria island, and did not go to Prince Albert sound, as had been anticipated. A few Prince Albert Sound Eskimos came to visit them in the spring, however. The party were moving most of the time, following the caribou, and

[1] Hanbury, David T. Sport and Travel in the Northland of Canada. London, 1904.

supplementing the caribou to some extent with fish caught in the lakes. They did not suffer from lack of food during the summer, but experienced considerable discomfort from being without fuel for either cooking or warming themselves for a good part of the time. Many districts visited did not afford a sufficient quantity even of dwarf willow or heather to make fires, and the people were obliged to eat their meat and fish in a raw state oftener than desirable. Mr. Jenness, however, had some very interesting experiences, and obtained a good understanding of the language, habits, folk-lore, and viewpoints on life in general, such as can only be obtained by continued intimate relations. During the winter he supplemented this with intensive studies of the winter snow-houses life, and many gramophone records of songs, shamanistic performances, and the like. Finger-prints of many of the people were recorded, and many of their string-games, or cats'-cradles were recorded.

The C.G.S. *Alaska* had arrived at Bernard harbour on September 5, 1915, after going from Baillie island to Herschel island for the mail and supplies. After discharging cargo, the *Alaska* went back west to Stapylton bay to look for drift-wood, as the amount of coal brought in was smaller than had been expected. Mr. Frits Johansen, marine biologist, had been in charge of the Bernard harbour station since the *North Star* had left on August 9, with only the cook and Patsy Klengenberg, interpreter, to help him. Mr. Johansen, who had been authorized, if conditions were possible, to do some dredging work on the *Alaska* after her return, accompanied the *Alaska* on the trip to Stapylton bay. He got some valuable deep soundings and dredgings in Dolphin and Union strait, down to a depth of 50 fathoms, and obtained a quantity of specimens from greater depths than he had been able to reach before. Mr. Johansen made continued studies of the fresh-water life of the ponds and lakes in the vicinity of the station, and made fairly complete collections of the flora and insect life. In the autumn he completed a series of soundings of the outer and inner harbours here, by means of holes through the young ice, in continuation of work begun in the autumn of 1914. The lines were run over the ice between islands and points of the main-land, with the soundings at paced distances, from 30 to 250 feet apart. The result was the finding of very interesting hydrographic conditions, the maximum depth inside of the islands being 12 fathoms. This information was of particular value in connection with his other marine investigations, and added materially to the topographic map of the harbour. Mr. Johansen also did some other hydrographic work in the neighbouring fresh-water lakes, by taking soundings through the young ice in the autumn.

The barren-ground caribou began to migrate across Dolphin and Union strait shortly after our return from the east, and were coming in fairly large numbers by November 15, 1915. About forty were taken before the end of the month (including about ten brought by Mr. Jenness from the south side of Victoria island), so a plentiful supply of fresh meat was on hand all winter. Salmon trout were also taken in some numbers up to the middle of December in nets set under the ice of the lakes near the station.

Captain Sweeney brought in the news that Mr. Daniel Wallace Blue, chief engineer of the C.G.S. *Alaska*, died at Baillie island, N.W.T., on May 2, 1915, after an illness of ten days. He had been troubled somewhat in the latter part of the winter by what Captain Sweeney thought was incipient scurvy. About the only noticeable symptom was that when his legs were punched with the finger, the indentations remained for a short time. Captain Sweeney and some of the natives at Baillie island had the same symptoms to some extent, as did also a trapper named Fred. Jacobsen who wintered around Liverpool bay, and Captain McIntyre and Mr. Arey on the *Argo* in Darnley bay. Mr. Jacobsen came over to Baillie island in the spring, and Mr. Blue accompanied him on a sled trip along the coast, after ptarmigan. They were all improving in condition as spring approached. A few days later, Mr. Jacobsen brought Mr. Blue back on the

sled, suffering from a severe congestion of the lungs. The pneumonic symptoms kept getting worse, and Mr. Blue died May 2. He was buried on cape Bathurst. Mr. Blue was one of the original crew shipped on the *Alaska* at Nome. He was a native of Ayrshire, Scotland, about 30 years old, and learned the steam engineering trade in Glasgow. He had lived in Alaska since 1906, and had followed the placer-mining industry (both prospecting and operating) on Copper river, Tanana, Nome, and Kobuk, Alaska. There was no other illness among the members of the Southern party, during the year 1915, except a slight illness of Mr. Jenness while he was spending the summer with the Eskimos on Victoria island.

Tidal observations were taken at Bernard harbour for a time in the spring of 1915, with the automatic tide-registering machine, but not very successfully, as the machine had a habit of stopping too frequently, and was finally discarded. In December, 1915, we secured tidal records continuously for one week, from December 4 to December 11; we erected a snow-house on the ice of Dolphin and Union strait, outside of the harbour islands, set up a long, graduated pole on the sea-bottom, and read the height of the tide every half hour, day and night, and at intervals of ten minutes or oftener around the periods of high and low tides. The maximum rise of tide recorded was about 2½ feet.

Only three or four families of Eskimos were around Bernard harbour in the late summer and early autumn of 1915, but about the middle of November they began to come up from the Coppermine River region, and from the south coast of Victoria island, until about 125 were living in a snow-house village on the beach near the station. Most of them stayed around for about three weeks, living principally on caribou meat, while their women were engaged in making new caribou-skin garments for the winter. All this work had to be done on land, as the natives of this region have superstitious taboos which forbid them dressing caribou-skins or making new caribou-skin garments while living on the ice. This was a happy time of the year for them, and there was singing and dancing going on most of the time. In the early part of December, when their new winter clothing was completed, and their stocks of frozen meat, dried meat, and fish began to run low, they all moved out to the vicinity of Liston and Sutton islands, in the middle of Dolphin and Union strait, about 16 miles north of Bernard harbour. The people build snow-houses on the ice there, and live practically exclusively on seals for the rest of the winter.

A good collection of mammals and birds was made around Bernard harbour in the spring and summer, and Mr. Jenness brought back a few zoological specimens from Victoria island. In the late summer I collected specimens at various points in the Bathurst inlet region. A good series of barren-ground caribou were collected during the autumn migration south from Victoria island. Some caribou specimens were obtained during the spring migration, some young fawns in June, and three good summer specimens, while we were in the eastern region. Specimens of fish were also taken whenever possible.

January and February, 1916, were spent by the geological and topographical men mostly in working up their field notes and preparing for the spring work. Mr. Jenness spent most of the winter at the large Eskimo sealing village near the Okullit (Liston and Sutton) islands, pursuing his ethnological studies. I made a trip to the first timber on the Coppermine river with some of the hunters in January and February, and a quantity of caribou meat was brought back to replenish the house supply, as well as a few specimens. Caribou were found to be fairly plentiful down to the coast near the mouth of the Coppermine river, and we also saw one small herd south of cape Lambert. Caribou are not often seen near the coast of Dolphin and Union strait in winter. The natives in this region spend the winter sealing through the ice, and at the present time do not molest the caribou from November until April.

At the outset of this trip, in January, I sent two of the Coronation gulf natives, named Mupfa and Kohoktak, in the employ of the expedition, to haul by sledge a quantity of provisions from the station at Bernard harbour to port Epworth, Coronation gulf, which was to serve as an outfitting base for Mr. Chipman's projected survey of the south side of Coronation gulf from the mouth of Rae river east to cape Barrow and for the return trip of the two or three sledges which would be working in the Bathurst inlet area until late in the spring of 1916. These two Eskimos, with their families, faithfully hauled and cached the goods safely, and on their return trip brought back to Bernard harbour several boxes of specimens which had been cached at port Epworth in the autumn. That spot was particularly favourable for making secure caches on account of the massive flat slabs of heavy shale lying loose on the island, affording ready material for making vermin-proof caches. Wolverines are surprisingly numerous on the coasts and islands of this region, far from the nearest timbered country, and nothing edible can be left long without being securely protected from them.

I returned to Bernard harbour from the Coppermine river trip on February 27, having been gone a little over a month. It had been arranged that K. G. Chipman should start on March 1 to make a survey of Croker river before starting the eastern work. This seems to be without doubt the largest river between Darnley bay and Coronation gulf, and nothing but its mouth had been put on the charts previously. I decided that I would accompany Mr. Chipman on this trip, which was of interest not only as giving an important geological section into the heart of the barren ground half-way between Mr. O'Neill's reconnaissance from Darnley bay, and Mr. Cox's traverse from the head of Rae river to Stapylton bay, but might also throw more light on animal distribution, particularly of the muskox. Owing to stormy weather we did not get away from Bernard harbour until March 6, and reached the mouth of Croker river on March 15. Near Clifton point we spent a night at "Camp Necessity," a little cabin built in the fall of 1915, by Rev. H. Girling, of the Anglican mission service, and his assistants, Mr. G. E. Merritt, of St. John, N.B., and Mr. W. H. B. Hoare, of Ottawa. They had intended to come farther east, but had been cast up with their little schooner nearly a hunderd miles west of the Eskimos they were intending to work among. Their schooner was apparently uninjured, and they expected to move in to Dolphin and Union strait in the summer of 1916, and establish a mission at Bernard harbour. The present western range of the Copper Eskimos extends usually to cape Bexley or South bay; west of that point is a 200-mile stretch of coast to cape Lyon permanently uninhabited, and usually uninhabited west to cape Bathurst, about 400 miles.

Croker river[1] has a broad delta, forming a triangle nearly equilateral, with base about 5 miles across at the coast, and apex about five miles inland, where the river emerges from a rampart of low hills. After leaving the hills, the river follows many devious channels, through many gravelly and stony bars and islands. There were a few small domes caused by ice rising up, but no recent signs of water flowing. The river seemed to be frozen to the bottom all the way up, so far as we could observe. The river is 60 to 70 yards wide where it emerges from the first rock (dolomite) cliffs about five miles from the coast. The cliffs a little inside the first bend of the river are about 60 feet high; they are composed of stratified dolomite, yellowish on the surface, but grayish on freshly broken surfaces, with some lighter-coloured bands, and lenses of calcite. The canyon walls on both sides became gradually higher inland, from 100 to 150 feet, vertical on both sides in most places. The river maintains a uniform width of about 60 yards, narrowing in one place to about 40 yards. Heavy snowdrifts overhung the west bank in many places (due to the prevailing winds), and there had been avalanches in places, making barrier ridges of very hard, ice-like, angular-

[1] Summary Report of the Geological Survey for 1916. Ottawa, 1917.

fractured snowblocks extending most of the way, and sometimes entirely, across the river. The river continually makes very short, sharp bends, but its general course is northerly. There are no tributary creeks entering the lower course of the river. At very frequent intervals the sides, walls, and brink of the canyon are castellated, or split vertically into sharp, angular, pointed pillars, spires, and minarets. One straight pillar in a bend of the river, was about 40 feet high and not over 3 feet thick at the base.

About 12 miles from the mouth of the river, and nearly 8 miles up the canyon, there is a broadening of the river where a large creek comes from the southeast, splitting to send a branch around a large, picturesque, pyramidal rock island about 300 feet high, before entering the river. This was the first place where we were able to get up out of the canyon and Mr. Chipman and I climbed to the top of the hill by cutting some niches and steps in the snowbanks. The top of the canyon walls were found to be 310 feet above the river, by aneroid, and the top of the ridge behind, 350 feet above the level of the river. We could see quite a bit of land on both sides of the river, and it appeared to be smooth, rolling upland. A little above this creek, the river narrowed abruptly to a gateway about 18 feet wide and over 300 feet high, and a little farther on to another gateway about 36 feet wide. Beyond this the river was wider, but the gorge was so much obstructed by avalanche barricades of icy-hard snowblocks that it was scarcely possible to take a loaded sled over them, so we decided to camp there, cache all but four days provisions, and scout ahead with a very light sled.

Before going farther up the river, we explored the tributary creek, got out of the creek canyon about 2 miles up and went up on the hills. The deep canyon of the river, cut down more than 300 feet through the dolomite, is not visible at a distance of more than half a mile. The country slopes gradually north to the coast of Amunsdsen gulf. The river canyon was seen to make a series of intricate bends a little above the creek, the loops coming nearly together. A little farther up, the river has quite a steep descent, with some rapids, if not waterfalls. The snowdrifts and ice barriers were so deep, however, in most places that it was impossible to see the character of the river. In some stretches of the river, progress was made only by climbing over one rugged hill of snow blocks, descending 20 or 30 feet into a deep pit, and immediately ascending another ridge, like working through pressure-ridge sea ice. We frequently had to boost and lift the sled up over ridges by main strength, and take the dogs out of harness to let the sled down. The rock strata are horizontal in most places, with some slight local variations of not more than 4 or 5 degrees. Quartz geodes, with brown and transparent crystals of topaz were frequent.

After going about 20 miles in the canyon, we came out suddenly on a snow-covered, hilly country, and at the mouth of a large creek coming from a northerly direction, about seven miles from mount Davy. A short distance south of the big canyon, there is another little canyon about three-quarters of a mile long and 20 to 30 feet deep, cut through dolomite overlain with gravelly knolls. At the upper end of the little gorge, the river cliffs are overlain with a sort of mud conglomerate—fragments of dolomite, granite and diabase, imbedded in yellowish-grey mud or clay. The tops of all the hills are covered with small stones, little angular fragments of dolomite, and a few boulders of granite and diabase. The ground is very barren everywhere, and gravelly where exposed through the thin crust of snow on the hill tops; no ground willows were seen on the hills, and only very scanty grass. Very rarely a single little sprig or two of willow would be found to have a foothold in a sheltered crevice in the bank of the river valley.

Mr. Chipman went to the top of mount Davy, which is the most conspicuous landmark from the coast from Inman river to some distance west of Croker river. He saw no rock exposures, the mountain being a hemispherical mound of gravel about 200 feet above the general level of the surrounding plain. Mount

Davy has an elevation of about 2,000 feet above sea-level by aneroid, agreeing very closely with its height as determined by triangulation from the coast. Some hills to the southward seemed to be higher than mount Davy. The Croker river valley extends comparatively straight to the south from this point for 10 or 15 miles. The hills south and southwest form a rather rugged-looking range, running approximately east and west. They are similar in appearance to the rather steep gravel ridges and knolls common along this coast, and no rock exposures could be seen. Above the little upper canyon, the river is rather broad for a distance, looking like a lake, and on the east side of this expansion is a low, broad, stony and gravelly flat. The only signs of life seen on the whole river trip were an Arctic fox track near mount Davy, a few Arctic hare tracks, and one hare which we killed. One raven was seen near the mouth of the river. We later learned from the missionaries that a few caribou came down to the coast a little east of here in the month of May. In 1915 we saw four caribou in May near Wise point, and one small bunch near Young point, but from the tracks it was evident that caribou were very scarce on the coast west of cape Bexley. The coast of this region seems to be too barren to afford sufficient pasturage for large numbers of caribou at any season. No signs of muskox were seen on the trip. We returned to the coast March 24, and reached Bernard harbour April 2. The coldest weather of the winter was recorded while we were in camp up the Croker river, 46 degrees below zero Fahrenheit at 6 a.m., March 21. The thermometer rose to 9 degrees below zero at 4.30 the same day. The minimum temperature at Bernard harbour the same day was 38 below zero, and the maximum 23 below zero.

D. Jenness, ethnologist of the expedition, accompanied by Mr. H. Girling, and Patsy Klengenberg, interpreter and assistant, left Bernard harbour February 15, and returned late in March. They visited a number of Eskimo villages on the ice of Coronation gulf east of cape Krusenstern (Nuvuk), near Tree river (Kogluktualuk), and near Hepburn island (Igluhugyuk), meeting a good many Eskimos that had not been seen before, and gaining considerable information in regard to the Kiluskitogmiut, who inhabit the Arctic sound and Bathurst inlet region usually in summer; the Havuktogmiut, from the central part of the coast of southern Victoria island; the Ekalluktogmiut, from farther east than the Havuktogmiut; and the Umingmuktogmiut from the eastern part of the Bathurst inlet region, and the Asiagmiut, from the same region and the eastern part of the Kent peninsula. They visited several villages on the ice about as far east as cape Barrow. A number of the eastern Eskimos came to the Bernard harbour station about the same time that Mr. Jenness returned, and many interesting gramophone records of the language and dialects were obtained. Earlier in the winter some Eskimos came from a greater distance to visit the station, notably a man named Kakshavik or Kakshavinna, calling himself a Pallirmiut, from the northwestern side of Hudson bay. He claimed to have come from a timbered country far to the eastward, and had traded at a white man's post, from his description apparently in the region of Baker lake or the Kazan river.

F. Johansen, naturalist, with Ovayuak (Eskimo) for companion, made a trip along the south shore of Victoria island, leaving the station March 6, and returning April 11, 1916. They crossed by way of the Liston and Sutton islands, Lady Franklin point, visited the Miles islands, and went along the Richardson islands as far as Murray point on the south shore of Victoria island. No Eskimos were seen except one group camped on the ice near cape Murray. He made such botanical collections as were possible at that season, took a few zoological specimens, and a number of specimens of rock at various points along the south shore of Victoria island. A few caribou were seen on southern Victoria island on March 19 and 21. The most important results of his trip were a number of species of fossil corals collected on one corner of Liston island in Dolphin and Union strait, as recognizable fossils are very hard to find in that whole region.

After his return, Mr. Johansen spent the rest of the season in completing his biological investigations near Bernard harbour, and in packing specimens and equipment preparatory to going out. His collections of plants and insects were practically complete for the region, and he made considerable additions to his collections and studies of fishes and marine and fresh-water invertebrates.

John J. O'Neill, geologist, and John R. Cox, topographer, started from Bernard harbour on March 17, 1916, to continue the survey of the copper-bearing area in the Bathurst inlet region. They took two sleds with them, so that they could work separately when desirable, and provisions for about ten weeks. They had for assistants, Ikey Bolt, an English-speaking point Hope Eskimo who had been with the expedition for over two years, and a Coronation gulf Eskimo with his family. Both the man and his wife had proved very useful in working, and they were familiar with the Bathurst inlet territory. O'Neill and Cox succeeded in cleaning up the work pretty well as planned. Tracing the southern contact or the copper-bearing diabase with the older rocks to Kannuyuk island, it was not thought advisable to waste the limited time at the disposal of the party in running a coast survey line to the southern tip of Bathurst inlet (which runs some distance south of the Arctic circle), and the time was spent in making a more complete geological sheet of the mainland and islands in the upper northwestern portion of Bathurst inlet. Over 200 islands were mapped in the region generally covered in the charts by Chapman, Lewes, and Marcet islands. The group consists of many small rocky islands which at a little distance have the appearance of forming a continuous coast line.

They found practically no game in that region in March and the early part of April, and no natives living much south of cape Barrow at that season. The natives say that the sealing is very poor in Bathurst inlet in winter and the people have to go out on the ice farther north and west in Coronation gulf. The season in Bathurst inlet seemed to be much later than it was in Dolphin and Union strait in 1916, as the seals did not begin to come up on the surface of the ice in Bathurst inlet until about May 20. The provisions of the party held out well, as they obtained plenty of caribou after the end of April. For fuel they used mostly distillate from the cape Barrow cache, burning it in Primus stoves, but later in the spring used dwarf willows from some of the islands. Early in the season they found the Eskimo snow-house and blubber-lamp useful and comfortable on occasion.

The work of O'Neill and Cox in March, April, and May, 1916, completed the survey east of cape Barrow practically as planned. Mr. O'Neill summarizes the results of the work in that region as follows:[1] " The copper-bearing rocks in Bathurst inlet occur on most of the islands west of a line running northwest-southeast from the east side of Lewes island, and north of Kannuyuk island. They cover most of the Banks peninsula and the western mainland shore from the mouth of Hood river to Moore bay, extending as much as 5 or 6 miles inland from the coast. These rocks are amygdaloids and form several successive layers which represent progressive, intermittent effusions of lava. Nearly all of them are impregnated with native copper over wide areas. The copper occurs in veins and in amygdules, and is disseminated as pepper throughout the groundmass. I have made a very conservative estimate of the amount of this copper-bearing rock (in which I actually saw native copper) and it seems that two billion (2 x 108) tons is well within the limit. It will be necessary to wait for analyses, and for the plotting of the map to give a close estimate of value of these deposits."

Kenneth G. Chipman, with Eskimo camp assistants, and Corporal W. V. Bruce, R.N.W.M.P., as voluntary aide, left Bernard harbour on April 12, 1916, to finish the survey of the south side of Coronation gulf east from the mouth

[1] Summary report of the Geological Survey for 1916, Ottawa 1917.

of Rae river (where John R. Cox left off in 1915) to cape Barrow. Mr. Chipman completed the survey up to cape Barrow by May 20. The Bathurst inlet survey parties were met here at an appointed rendezvous, and we all went west together to the mouth of the Coppermine river.

After returning from the Croker river survey trip, I spent some time at the station arranging for the spring work and getting all accumulated zoological specimens taken care of before warm weather should set in, and finally started east with a sled and one Eskimo boy as an assistant, to make a trip into the Arctic sound and Bathurst inlet region to investigate the occurrence of the muskox, and other distributional problems of the fauna, as well as look up and assist the various surveying parties on their return. Mr. J. E. Hoff, chief engineer of the *Alaska*, with Mike, his Siberian Eskimo assistant engineer, went along as far as the mouth of Tree river, where they took out the launch motor and the Evinrude motor, and hauled them back to Bernard harbour. The hull of the launch was abandoned as it was badly worn and cut up, and the skin umiak was left for the last sled party to take back. The skin cover of the umiak had been removed the previous autumn, folded up and placed in a cache of slate slabs to protect it from vermin during the winter, and only needed to be soaked up and stretched over the canoe-frame again. The skin umiak is a very practicable means of crossing leads in the early summer, and I considered it advisable to have it on board the *Alaska* in case of accident in ice-crushes when travelling to point Barrow. The umiak is light and may be readily hauled over the ice where a wooden boat would be stoven.

The snow began to melt on the land much earlier than we had anticipated, being pretty soft by May 19, and I could not make the projected inland trip south of Arctic sound. I met O'Neill and Cox in Bathurst inlet, east of point Wollaston, and returned to cape Barrow with them, meeting Mr. Chipman's party again on May 21. There was much water on the ice around cape Barrow May 21, and much slushy snow and water until we got back to Tree river. We remained at the island at the entrance of the harbour from 3.45 a.m., May 25, until 10.30 p.m., May 27, putting the umiak in shape and getting some dog pack-saddles made for Mr. Chipman. Mr. Chipman had met the Royal Northwest Mounted Police patrol from Great Bear lake near the mouth of the Coppermine river early in the month, and arrangements had been made that he should go back to Great Bear lake overland with Mr. D'Arcy Arden, who had come down with the police patrol. Mr. Chipman wanted to go out by the overland route because his work here was finished, and the prospect was good that he could get out a little sooner by fort Norman and the Mackenzie river, and it was desirable to have news of the Southern party's condition and welfare get outside, in case the remainder of the party on the *Alaska* should be prevented by shipwreck or ice conditions from getting out by way of point Barrow and Nome, Alaska. Mr. Chipman reached the end of the telegraph line at Peace river crossing on August 18, and Ottawa about the end of the month.

It was evident that Franklin was labouring under a misapprehension when he applied the name of Tree river to the river flowing into port Epworth. The Eskimos call this river Kogluktualuk (river with big rapids.[1] In describing his interview with the aged Eskimo Terreganoeuck, or the White Fox, near the mouth of the Coppermine river, June 16, 1821, he says: " He had no knowledge of the coast to the eastward beyond the next river, which he called Nappaarktok-towock, or Tree river." Franklin accordingly charted the next river which we observed as Tree river, about 65 miles east of the mouth of the Coppermine. The old Eskimo was evidently referring to the small river which they still call Naparktoktuak (na-park-tok—spruce tree), flowing out through steep clay hills about 10 miles east of the Coppermine. I crossed this stream in the

[1] Narative of a journey to the shores of the Polar Sea, in the years 1819, 1820, 1821 and 1822 by John Franklyn, Captain, R.N., F.R.S., and Commander of the Expedition. London, 1823, p. 352.

spring of 1911 while making a portage from the mouth of the small Kogaryuak river (18 miles east of the Coppermine) to Bloody fall, and found a few small spruce growing in the valley within 10 miles of the coast, several miles north of the northern limit of trees on the Coppermine river itself.

Sending one large sled load of specimens with some of our Eskimos directly from port Epworth to Bernard harbour via cape Krusenstern, we started west at 10.30 p.m., May 27. West of port Epworth we found that most of the melted snow water had drained off through cracks in the ice, making sled travel much better. The section of the coast from the Coppermine river to port Epworth as mapped by Mr. Chipman in 1916, lies substantially as indicated on the old charts. The only rivers of any consequence are the big Kogaryuak, emptying about 25 miles west of port Epworth, and a smaller stream, also called Kogaryuak by the natives, flowing into Coronation gulf about 18 miles east of the Coppermine. In 1910-11, Capt. Jos. F. Bernard wintered inside the mouth of the latter river with the schooner *Teddy Bear*, drawing about 6 feet of water. All these rivers have falls or rapids a few miles from the coast. East of port Epworth, considerable rectification of the chart was made around Gray's bay, locating the Annielik, Koguktuaryuk, and Utkusikaluk (Wentzell) rivers, and several long narrow inlets and many granite islands between Gray's bay and cape Barrow. A point of interest was the great length of the inlet at Inman harbour, a very deep, narrow fjord, the bottom of which is separated by a low portage of half a mile from another deep inlet running in from the east side of cape Barrow, between cape Barrow and Detention harbour, nearly making an island of the cape Barrow peninsula. For the convenience of future travellers, we have adhered to the policy of retaining the native place names where these can be ascertained, but as this inlet seems to be unnamed, we propose the name Desbarats inlet, in honour of the Deputy Minister, Department of the Naval Service, who directed the general affairs of the expedition, and to whose careful and continued attention and interest the members of all the parties are deeply indebted.

The united sledge parties returned together along the coast as far as the mouth of the Coppermine river, which was reached on the morning of May 31. The river was open to its mouth, and was flooding the ice for about half a mile outside of its mouth. About 125 Eskimos were encamped a little west of the mouth of the river, on the southeast shore of Richardson bay. Most of them were preparing to start packing overland to Dismal lake and Dease river, although two or three families were intending to spend the summer hunting caribou around the Rae river, and three or four of the least enterprising families and some older people were intending to spend the summer spearing fish at the rapids of Bloody fall, about nine miles from the mouth of the river. Mr. Chipman and Mr. Arden left the mouth of the Coppermine river on June 1, to pack across country to Great Bear lake with some good pack dogs, while the rest of our party started at the same time to the station at Bernard harbour, going a little out of the way to re-examine some geological formations at cape Kendall and cape Hearne, on the west side of Coronation gulf. Part of the way we had to wade through about one foot of water on the ice, but after passing north of cape Hearne, the weather turned cooler and froze a crust on the fresh water which was on top of the sea ice, strong enough to bear up our sleds, and travelling was more easy. Considerable stretches of open water were seen south and west of Lambert island June 5 and 6. The ice is said to be very thin there even in winter and opens up very early in the spring. Great numbers of Pacific and King Eider ducks were seen in the water and on the ice at the water's edge. We reached Bernard harbour June 6, and found everybody well except Captain Sweeney, who had injured his hand while working on the ship. The wound became infected and his arm was badly swollen and had to be operated on several times, so that he did not recover the use of it for several weeks.

Mr. George H. Wilkins, with the Herschel island Eskimo Palaiyak, reached Bernard harbour on June 15, 1916, having come by sled from the headquarters of the Northern division of the expedition, near the Princess Royal islands, Prince of Wales strait, coming down the southern part of that strait, and crossing Minto inlet, Prince Albert sound, and Dolphin and Union strait. Mr. Wilkins brought news of the safety of the three vessels of the Northern party, and of the progress of their operations up to May 5, 1916. The *Mary Sachs* was still at cape Kellett, southwestern Banks island, where she had been hauled up since 1914, in charge of Capt. Peter Bernard, with some Eskimo assistants. The *North Star* had been hauled safely up on a small island north of Robillard island on the northwest coast of Banks island in the autumn of 1915, and the crew had gone over to join the *Polar Bear* party in the winter. The *Polar Bear* had attempted to go up through Prince of Wales strait on the east side of Banks island, but was unable to get beyond Armstrong point, and wintered between Armstrong point and the Princess Royal islands. At the time Mr. Wilkins left in May, Mr. Stefansson contemplated carrying on his travels on the northern islands until 1917, the *Polar Bear* having been directed to move its base to Winter harbour, Melville island, to spend the winter of 1916-17, with the possibility of the party remaining in the Arctic until 1918. The Northern party was stated to have provisions for one or two years more, and were killing and storing away large numbers of caribou and muskoxen on Melville island in the spring of 1916. Quite a number of their engaged western Eskimo hunters had been sent up to Melville island early in the spring to shoot caribou and muskoxen for the party's meat supply.

The remainder of June and the early part of July were spent in completing collections in the vicinity of Bernard harbour, and assembling and packing specimens, stores, and equipment for shipment out of the Arctic. Space had to be economized on the *Alaska* going out, as far as Herschel island, as we had to bring out twenty-seven people on the small schooner, viz., eleven white men, including six members of the scientific staff, a crew of three, and two members of the Royal Northwest Mounted Police; fourteen Eskimo employees, seven men, three women, and four children; and two Eskimos held by the Mounted Police for homicide. In addition to this we had to take the Eskimos' personal camp gear and dogs, stores for paying off native employees at Baillie island and Herschel island, and enough reserve provisions to provide for the wintering of as many men as might remain with the *Alaska* to take care of the vessel and bring her out the next year in case we should be prevented by ice conditions from sailing from Dolphin and Union strait to Nome in the summer and autumn of 1916. I also thought it necessary, for the same reason, to keep the skin umiak, two sleds, and two teams of dogs on board at least as far as point Barrow, Alaska.

In September, 1915, Corporal W. V. Bruce, R.N.W.M.P., came in from Herschel island, Y.T., on the return trip of the C.G.S. *Alaska*, to work on the case of the disappearance of Father Rouvier, O.M.I., and Father LeRoux, O.M.I., from the Mission at fort Norman, who had gone into the country northeast of Great Bear lake in 1913, and had not been heard of since.[1] Corporal Bruce had spent the winter working on the case, and with the assistance of various members of the expedition, gained considerable information and recovered a quantity of the personal effects of the missing fathers as well as some property which presumably belonged to Messrs. Radford and Street, who were killed by Eskimos in Bathurst inlet in 1912. In May, 1916, Inspector Charles D. LaNauze, of the Great Bear lake patrol,[1] came down to Coronation gulf with a party from his winter quarters near old fort Confidence on Dease river, and in the same month the police made prisoners of the two Eskimos, Sinnisiak and Uluksuk,

[1] Report of the R.N.W.M.P. for 1916. 7 George V., Sessional Paper No. 28. A. 1917. Ottawa.

who had killed the priests. Uluksuk was taken on one of the islands near the mouth of the Coppermine river, and Sinnisiak was taken on the south coast of Victoria island. Both prisoners were taken to Bernard harbour, and in July we took Inspector LaNauze and Corporal Bruce out as passengers on the *Alaska* from Bernard harbour to Herschel island. All relations of the Royal Northwest Mounted Police with the expedition have been most cordial, and while with the expedition, both Inspector LaNauze and Corporal Bruce did everything they could as volunteer assistants in whatever work was going on. The members of the expedition have also had many courtesies and much assistance in their work from Inspector J. W. Phillips, who was in command of the R.N.W.M.P. detachments at Herschel island and fort McPherson from 1913 to 1916, and from the members of his command, for which we are very appreciative.

The *Alaska* left a large permanent cache of provisions in the house formerly occupied by the Southern party at Bernard harbour, in case any parties should come down from the Northern party during the next winter. The house was left in custody of the Rev. H. Girling, who wintered near Clifton point with the mission schooner *Atkoon*, and intended to establish a mission station at Bernard harbour in the summer of 1916. This ensured our cache being protected from marauding natives.

The Hudson's Bay Company's schooner *Fort McPherson*, with Mr. W. G. Phillips in charge, sailed from Herschel island July 28, 1916, after our arrival there, for the purpose of establishing a permanent trading post for the company at Bernard harbour. As there are now trading posts of the Hudson's Bay Company at Herschel island, at Kittigazuit (east branch of the Mackenzie delta), at Baillie island, and Bernard harbour (the latter post having been satisfactorily established, from later advices), any parties from the Northern party of the expedition who may come to the mainland coast east of Herschel island will have little difficulty in getting provisions. The larger part of the Canadian Arctic Expedition stores remaining at Herschel island were mostly landed by the *Ruby* in 1915, after the *Alaska* had taken her required stores and sailed east again in 1915, and Mr. Stefansson's vessels had also taken what they were able to carry.

The work of loading the *Alaska* was begun in the summer of 1916 as soon as the vessel was loose from the ice in which she had been frozen all winter, and we succeeded in getting out of Bernard harbour much earlier than was anticipated. In the summer of 1915, prolonged northwesterly winds in the latter part of July had caused a local jam of ice in Dolphin and Union strait, and the *North Star* was not able to get away from Bernard harbour until August 9. The *Alaska*, with all members of the Southern party on board, left our headquarters for the past two years, at Bernard harbour, 7.30 p.m., July 13, 1916, and after working through some loose areas of bay ice, reached the vicinity of Young point on July 17. Here we met with masses of heavy floating ice, too heavy for us to make progress through. We were delayed near Young point for several days, tying up to heavy grounded cakes of ice along the beach, and were obliged to shift our position frequently, because the ice floes behind which we were sheltered shifted their position frequently as the tide rose and fell. The smooth rock bottom along the coast in this region prevented the big ice masses from grounding as hard and fast as they are accustomed to do on the mud and sand bottoms which are found west of cape Bathurst.

We got under way again in the evening of July 21, and worked out into a broad lead of open water outside the strip of loose, moving masses of ice which was pressing down along the mainland shore of the south side of Amundsen gulf and Dolphin and Union strait. After getting through this shore ice, we found it did not extend much west of Croker river, and that the ocean was practically open to the westward. We reached Pierce point harbour about midnight on

July 23, crossed Darnley bay and reached cape Parry on the morning of July 24. We stopped at cape Parry for a short time to get a time observation, and then went ahead across Franklin bay, reaching cape Bathurst at 10.05 p.m. the same evening. The Eskimo village and the new trading station of the Hudson's Bay Company, the most northerly trading post in Canada (70° 35′ north, 128° 05′ west) is at the tip of the long sandspit running west from cape Bathurst, about half a mile east of the east end of Baillie island.

At Baillie island, I discharged and paid off Ikey Bolt or Angatitsiak (point Hope Eskimo), Mungalina (Baillie island Eskimo), and Patsy Klengenberg, interpreter and general assistant. The latter, the 17-year-old son of Capt. Christian Klengenberg, is an extraordinarily intelligent and resourceful young man, a very capable hunter and traveller, showed great aptitude in the collection and preparation of specimens, and is probably the best qualified Eskimo interpreter in the country, being familiar with all the dialects from point Barrow to Coronation gulf. The people who left at Baillie island were paid principally in stores. There was a heavy northwest gale while we were in the shelter of the cape Bathurst sandspit on July 25 and 26. We left Baillie island at 7 p.m., July 26, and reached Herschel island 2.30 p.m., July 28, having been bothered very little by ice anywhere west of Croker river.

At Herschel island I landed some surplus stores from the *Alaska*, including 1,050 pounds of pemmican, 250 pounds rolled oats, 1 barrel beef, 412 pounds tobacco, and some miscellaneous equipment, storing them with the other expedition stores at Herschel island, in charge of the Royal Northwest Mounted Police, retaining on board the *Alaska* enough provisions to winter a certain number of men in case the vessel should be caught again by ice on the north coast of Alaska. I made as complete a survey of Canadian Arctic Expedition stores at Herschel island as the time would permit. The provisions there at the time we left, exclusive of a certain amount set aside to be shipped to Banks island, were as follows:—

	Pounds.
Rolled oats, 108 50-lb. cases	5,400
Sugar, granulated, 6 50-lb. boxes	300
" 5 200-lb. boxes	1,000
" 20 100-lb. brls	2,000
Dog biscuit, 11 50-lb. cases	550
Cracklings, 55 50-lb. cases	2,750
Rice, mostly brown, 36 50-lb. cases	1,800
Beef, 1 brl	100
Total	13,900

Acting in consultation with Mr. George H. Wilkins, who had recently come down from the Northern party, and was conversant with their resources and their needs, we set aside certain provisions, and other equipment, amounting to about two tons weight, and requested the commander of the R. N. W. M. P. detachment at Herschel island to try to get any whaling or trading ship which might come in during the summer of 1916, and intended to cruise in the vicinity of cape Kellett, Banks island, to take these goods on board and try to land them for the Northern party of the expedition at cape Kellett, Banks island, securing as good rates for this freighting as he could. I have later received information from the police at Herschel island, that the selected goods were taken by Capt. C. T. Pedersen, steamship *Herman*, of San Francisco, and landed at cape Kellett, Banks island, in the latter part of August, 1916. Capt. Pedersen made the very reasonable rate of $50 per ton for two tons from Herschel island to cape Kellett. It was also stated that Capt. P. Bernard of the *Mary Sachs* had purchased a

considerable quantity of additional supplies from the *Herman*. The stores which were shipped from Herschel island to cape Kellett included:—

	Pounds.
Pemmican, man, 17 50-lb. cases	850
" dog, 4 50-lb. cases	200
Cracklings, 20 50-lb. cases	1,000
Rolled oats, 6 50-lb. cases	300
Brown rice, 6 50-lb. cases	300
Sounding wire, 1 coil.	
Miscellaneous equipment.	
Mail for the Northern party.	

I am informed that Capt. Peter Bernard intended to make a sled trip from cape Kellett to Winter harbour, Melville island, in the fall of 1916 to bring up the mail which was sent in during the summer of 1916 to the Northern party.

At Herschel island, Yukon Territory, I discharged and paid off the remaining Eskimos in the employ of the Southern party, including Mike and his wife; Ambrose Aganvigak and his wife Unalina; Adam Ovayuak; and Silas Palaiyak; paying them as far as possible in stores remaining on the *Alaska*, and partially in cash. The *Alaska* left Herschel island for the westward on August 3, 1916, at which date no ship had yet arrived at Herschel island from the westward. We had on board nine men: Daniel Sweeney, sailing master; J. E. Hoff, chief engineer; James Sullivan, cook; scientific staff consisting of J. J. O'Neill, geologist; J. R. Cox, topographer; D. Jenness, ethnologist; F. Johansen, biologist; George H. Wilkins, cinematographer and photographer; and Rudolph M. Anderson, zoologist, in command.

Very little ice had been seen east of Herschel island, but we soon found it pretty heavy a little west of the island, although loose and moving freely, practically all the way west from the international boundary (141st meridian) to point Barrow, Alaska. We stopped long enough at the international boundary monument to get a time sight. One ship was seen on the way in, the *Herman*, but we could not speak to her as she was in the moving ice outside of Cross island, Alaska, on August 5, 1916, while we were inside of the chain of islands which includes Cross island. On account of the heavy ice outside, we again availed ourselves of the knowledge of the very excellent detailed sounding and charting done recently by Mr. E. deK. Leffingwell, and went into the inside passage behind the chain of low, sandy islands west of Flaxman island, coming out again between Midway island and Return reef. The channel inside of these islands is rather shoal, but is valuable for vessels drawing not more than two fathoms. A vessel of that draught could come in behind Flaxman island, but shoals prevent a vessel drawing more than 5 or 6 feet going out through the channel between the east end of Flaxman island and the mainland, that channel being shoal and foul from silt deposited by the Canning river. The pack ice was pretty heavy around point Barrow, and we had some difficulty in getting through, but after passing cape Smyth, about five miles southwest of point Barrow, no more ice was seen.

We left cape Smyth, which is the site of the village, including trading station, mission, government school, and the post office of Barrow, Alaska, the most northerly United States post office, on August 8, 1916. No ice was encountered south of cape Smyth, and we had a good run down to point Hope, where we stopped for a short time on August 10. Continuing across the outside of Kotzebue sound, we reached cape Prince of Wales and passed through Bering strait into Bering sea at the beginning of a heavy, prolonged northwest gale, on the evening of August 11, 1916. As the gale continued we were obliged to anchor for some time under the bluffs at cape York and Tin City, and again behind Sledge island, reaching Nome roadstead about 5 a.m., August 15, 1916.

The *Alaska* had not been leaking at all before passing point Barrow, but after passing that point began to leak badly around the stuffing-box; this

necessitated considerable pumping to keep the engine room from being flooded and put out of commission. Although the weather was a little rough when we reached Nome, I succeeded in getting the cargo of specimens and stores lightered ashore that day and put on the wharf of the Alaska Lighterage and Commercial Company. It was too rough to make any repairs on the vessel, and as the weather was rougher the next day, August 16, the *Alaska* was compelled to run 16 miles over to the shelter of Sledge island again. Three sailors had been temporarily engaged upon our arrival at Nome, and the six members of the scientific staff were relieved from seaman's duty and allowed to go ashore. They had all been doing watch as deck officers from Bernard harbour to Herschel island with our Eskimo crew, and from Herschel island to Nome the duties had been much heavier. The storm abated somewhat on August 18, and the *Alaska* returned to the roadstead, but the surf was still too heavy to make a landing. The *Alaska* was ultimately hauled up high and dry on the beach at Nome and left in the charge of the Alaska Lighterage and Commercial Company for final disposal by the Department of the Naval Service. The vessel was in good shape, except for the engines, the leakage around the stuffing-box being a trifling matter, which could be readily repaired when the vessel was hauled up.

The extensive collections made by the party in geology and mineralogy, ethnology, and archaeology, terrestrial and marine biology, botany and photography, and the records and papers of the Southern party, were thus landed safely at Nome. As it was considered much safer to ship the results of our three years' work out by the regular freight and passenger service from Nome than to risk taking them down on the north Pacific to Victoria on a small schooner like the *Alaska* in the autumn season, all the collections, scientific instruments, and what equipment was worth shipping back, was trans-shipped to Seattle on the steamship *Northwestern*, of the Alaska Steamship Company. The members of the party also took passage to Seattle on the same steamer, leaving Nome August 27, and reaching Seattle via the inside passage on September 11, 1916. All collections had been safely received in Ottawa by the end of October, 1916.

To summarize: The scientific work of the Southern party was completed substantially as outlined in our plans of last year, and although some time was lost on account of adverse ice conditions in 1913, all members of the party feel that in the main the results of their work, for the past two years at least, have been as satisfactory and extensive as they anticipated, considering the difficulties which are to be encountered in working in such remote fields.

The two topographers of the Southern party, Kenneth G. Chipman and John R. Cox, have completed the survey of the mainland coast in detail, on the scale of 10 miles to the inch, from the Alaska-Yukon Territory international boundary (the 141st meridian) to the Mackenzie river, made a traverse of Firth river, Y.T., surveyed the eastern and western branches of the Mackenzie delta, and the mainland coast from the west side of Darnley bay (on the Cape Parry peninsula) to a point well down in Bathurst inlet (south of Kannuyuk island), including a large number of islands in the Coronation gulf and Bathurst inlet regions, all on the same scale. Several of the hitherto unexplored rivers in this region have been traversed, including Hornaday river flowing into the south side of Darnley bay, Croker river flowing into the Amundsen gulf, Rae river flowing into the west side and Tree river (Kogluktualuk) flowing into the south side of Coronation gulf, and an examination made of the territory around the mouth of Hood river flowing into Arctic sound. Collinson point harbour, and about 10 square miles surrounding it, and Bernard harbour, Chantry island, and the country immediately surrounding these places have been surveyed on the scale of $\frac{1}{24000}$, and mapped with 20-foot contours. The geological features have been investigated by J. J. O'Neill, and the relations of the different formations studied in detail at the most important points of contact.

The most important result of the geological investigations was the detailed mapping and estimation of the available copper-bearing rock in a great new area hitherto very slightly known in the Bathurst inlet region. So far as analysed, the ore is low-grade, but further prospecting may locate veins and richer areas to render mining operations more profitable. Isolated nuggets of float copper of considerable size are found in the region. Galena was found by the party, and other minerals doubtless occur. The whole region forms a great copper reservoir for Canada, and will no doubt be utilized in the future, when transporation problems are solved, as they are not farther north than paying properties in Alaska and Norway, and much farther south than working mines in Spitzbergen. The climate is not too bad; there is a summer of about four months, and the snowfall is light in winter.

D. Jenness, ethnologist and anthropologist of the party, has made extensive ethnological collections, from Arctic Alaska as well as in the Coronation gulf, Dolphin and Union strait, and Victoria island region, and also about one hundred gramophone records of folklore, language, dance songs, and shamanistic performances, with careful transcriptions and translations of them. He has made a collection of cats'-cradle games from the different Eskimo tribes, numbering over one hundred and forty. Their language and vocabularies, the manners, social and religious customs, games, amusements, and general culture have been carefully studied and the information recorded. With the present rapid advance of civilized ideas and customs into this particular region, it is certain that much of this information could not be obtained at a later time. The habits of the Eskimos are changing with a rapidity which is astonishing to those not conversant with the situation; improved weapons and methods of trapping reduce the game and compel shifting of tribal localities, while from the history of the past, it seems very likely that contact with the fringe of civilization will rapidly decimate the numbers of the Copper Eskimos as it has done to the Eskimos farther west.

F. Johansen, marine biologist, entomologist, and botanist, has made extensive collections in all these branches, from Arctic Alaska and Canada. He has succeeded in rearing and working out the hitherto unknown life-histories of a number of little-known Arctic insects, and made many interesting and successful sea dredgings and soundings. George H. Wilkins has made many studies with camera and cinematograph, making over one thousand film and glass plate negatives and about 9,000 feet of cinematograph exposures, of Eskimo life, natural-history objects, and Arctic scenery and topography. All the members of the scientific staff made numbers of photographs also to illustrate their work.

In mammalogy and ornithology, fairly complete collections were made in the regions traversed, although the difficulties of transportation and the pressure of other duties often prevented the obtaining of as large series as might be desirable. The collection of birds numbers six hundred and nineteen (619) specimens, including seventy-three (73) species. The collection of mammals numbers four hundred and thirty-one (431) specimens, including twenty-two (22) species and probably several more subspecies. It is not possible to tell without more detailed examination whether any new forms are represented, but many specimens represent seasonal changes of plumage and pelage which are rare in collections, and the specimens taken will largely extend the geographical range of a number of species. This branch of the work was in charge of R. M. Anderson, but all members of the expedition aided materially in bringing in specimens and notes.

A mere list of the different groups represented in the expedition's biological collections indicates something of their scope:—

Mammals, birds, fishes, insects, plants, crustaceans, echinoderms, sponges, cirripedes or barnacles, molluscs, hydroid zoophytes, medusæ and ctenophores, alcyonarians and actinians, algæ, protozoa (foraminifera and radiolaria), plankton, sporozoa, diatoms, infusoria, pteropods, cephalopods, decapods,

phyllopods, copepods, schizopods, amphipods, isopods, pantopods, annelids, platyhelminthes, rotatoria, nematodes, nemertines, malacostraca, bryozoa, ascidians, peridiniales, ostracods, hirudinea chaetognatha, polychaeta.

On the biological side, to arrange for having the different groups worked up and the reports adequately published, an Arctic Biological Committee has been appointed jointly by the Department of the Naval Service and the Geological Survey, with the Dominion Commissioner of Fisheries, Prof. E. E. Prince, as chairman; Prof. A. B. MacCallum, of Toronto; the Dominion Entomologist, Dr. C. Gordon Hewitt; Mr. James Macoun, botanist, of the Geological Survey and R. M. Anderson, representing the expedition and the zoological division of the survey. The specimens to be worked up represent over forty distinct groups, each of which will require a separate chapter or report. Some of the larger groups, such as the insects, have been divided among several different men, mostly in the entomological division of the Department of Agriculture. A great many of these collections represent specimens of groups which have never been collected anywhere in the western Arctic area, and practically all of them are from districts and localities which are practically unrepresented in collections anywhere, from regions never visited before by a collector.

As far as possible these collections are being worked up by Canadian specialists, but some groups have necessarily been sent away because there was no satisfactory material in Canada for comparison. The Smithsonian Institution is well supplied with Alaskan Arctic material in some groups, and the British Museum with material from various Arctic expeditions, while the Greenland region is best represented by Danish and Norwegian collections, consequently a number of groups of specimens are being sent to some of those countries for determination. When the collections have been properly determined and worked up, Canada's museum will have a good start in the representation of the production and content of a very large area that has hitherto been very poorly represented. The specimens are being placed in the hands of the best available specialists, and these men have shown a gratifying willingness to do what they can to help unravel the problems presented so that we have satisfaction in knowing that such additions to knowledge as were obtained by the Canadian Arctic Expedition of 1913-16 may soon be made available to the public of Canada and to the world.

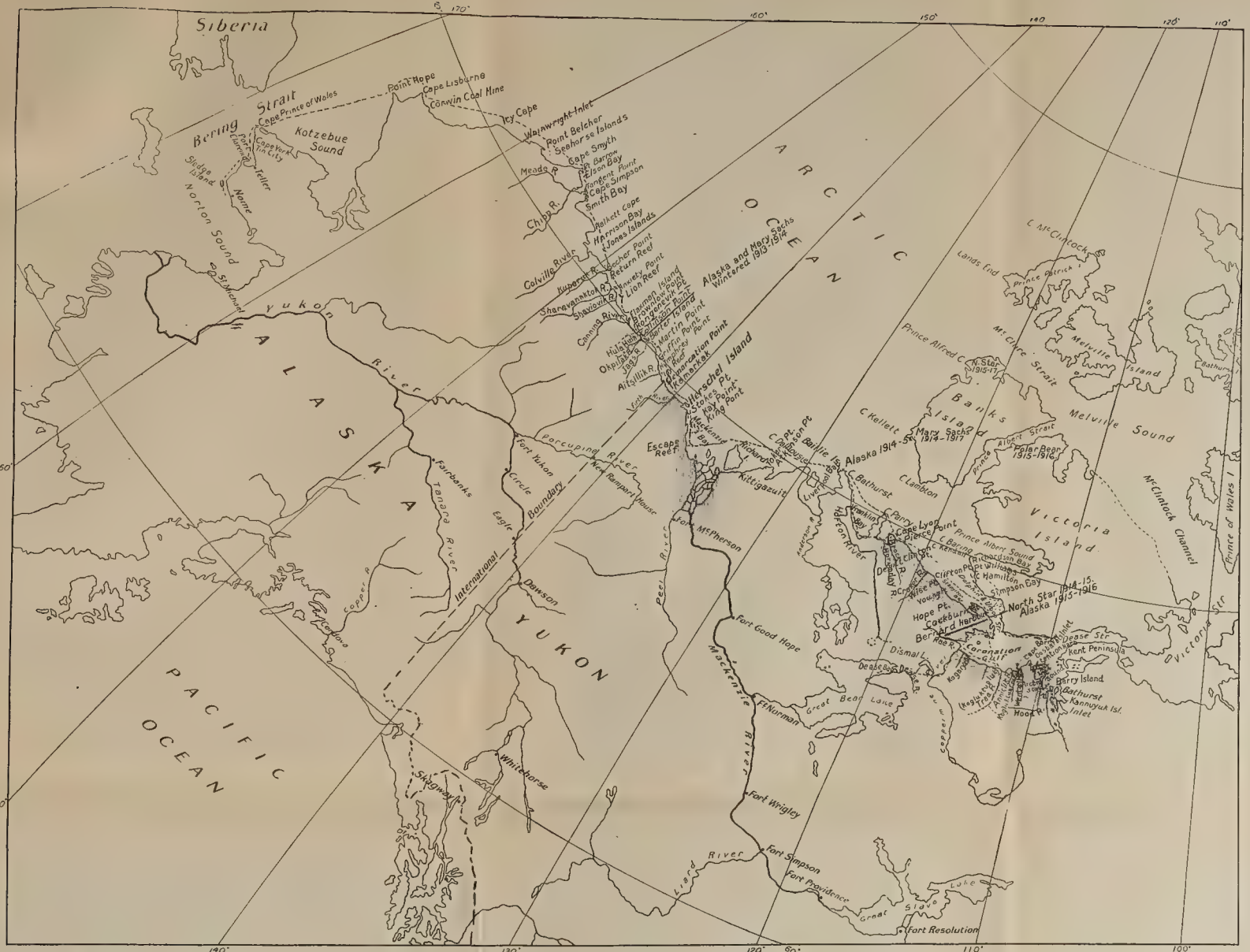
Full meteorological observations were kept up for three years, with barograph, thermograph; maximum, minimum, and standard thermometers; mercurial barometer, and anomometer. Tidal observations were taken for some time at Collinson point, Alaska; at Demarcation point, and at Bernard harbour, Dolphin and Union strait.

The Geological Survey, Department of Mines, is attending to the computing and plotting of the maps surveyed, in its Topographical Division, and the technical geological and ethnological reports in the Geological and Anthropological Divisions, respectively. Full reports of the various scientific activities of the members of the Southern division of the Canadian Arctic Expedition of 1913-16 are in course of preparation, and will be transmitted to the various departments as soon as completed.

I have the honour to be sir,
Your obedient servant,

RUDOLPH MARTIN ANDERSON,
Chief of the Southern Division of the
Canadian Arctic Expedition of 1913-1916.

Zoologist, The Geological Survey,
Ottawa.



WITH NUMEROUS ADDITIONS SKETCHED IN
ILLUSTRATING FIELD OF WORK OF SOUTHERN DIVISION
OF THE CANADIAN ARCTIC EXPEDITION OF 1913 1916

DOTTED LINES TRAVERSED BY SLED OR BOAT
BUT NOT PROPERLY SURVEYED

AREAS SHADED SURVEYED
AND CHARTED 10 MILES TO 1 INCH

From map compiled by Topographic Division of the Geological Survey.

21277

III. Report on Topographical and Geographical Work

BY

GEO. H. WILKINS

Report of George H. Wilkins on the Topographical and Geographical Work carried out by him in connection with the Canadian Arctic Expedition.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

Sir,—I beg to report the following information on the Topographical and Geographical work carried out by me during my journeys in connection with the Canadian Arctic Expedition.

This report is mostly confined to observations made on Banks island and the vicinity for the other parts visited were either covered by the Topographers of the Expedition or by others of the party previous to my traverse.

In 1914, when proceeding in the *Mary Sachs* to meet Mr. Stefansson, we approached Banks island in a fog and the first sight of the coast that we obtained was in the vicinity of cape Lambton, which is a blunted point rising abruptly from the water to a height of fifty feet or more and shelving back about a hundred yards to rise again almost perpendicularly to almost 800 feet. The cliffs and mountains beyond were barren and rugged in appearance from the south; deeply scarred by ravines and studded here and there with boulders.

As we proceeded along the coast to the northwest we drew away from the higher cliffs and the mountains receded to undulating hills of a thousand feet or more in height. Numerous small but rapid streams had been noticed coursing through the ravines, and about fifteen miles northwest from the cape a fair-sized river enters the sea through a narrow valley. The source of this river is evidently in the mountains back of Nelson head, but for a mile or so along the coast it runs from west to east. Two ranges of hills extend parallel to the coast towards cape Kellett, intersected here and there by rivers cutting through them to the sea. We found Thesiger Bay to be more like two bays than one and we could not see cape Kellett until around a point some 17 miles from there.

The southwest coastline ends for the most part in cut-banks which are gradually washing away into the sea each summer, but here and there along the coast there are sandspits sheltering lagoon mouthed creeks or rivers. Once around the point in Thesiger bay one sees two islands not marked as yet on the Admiralty chart 2118, and a semi-circular sandspit reaching out towards them from the mainland. Behind the islands and the sandspit is good shelter for a boat of shallow draft, and we used a ten-foot channel close beside the sandspit to get into shelter.

Stretching inland from behind the islands is a narrow bay about two miles deep and it seems likely that there is a channel to get into this from the south side of the islands, but we had not time to sound these waters.

Cape Kellett is not at all like what one would expect from the chart. The sloping hills end much more abruptly and form a much less conspicuous hook, although a half-moon shaped sandspit does extend out in the nature indicated for three miles or so and half a mile in width. Behind this there is also shelter from a southwest and southeast wind, but from observation it seems that if there is ice about it will pack tightly on the cape and severely hamper any vessel trying to get out.

Another thing that makes this point very troublesome to navigate is the strong set of the current from north to southeast around the cape. It has

always had the same direction when I have had the opportunity to observe it, but we were unable to make sufficient observations to prove that this is always so.

From cape Kellett northward the land recedes to form a shallow bay as indicated on the map, and emptying into it is a broad but shallow river which has its source amongst the hills behind cape Lambton. Along this bay, and as a matter of fact the greater part of the western coast the beach is low and broken up by numerous lagoons whose waters lap the tundra at high tide. Long estuaries at intervals stretch in towards the rolling hills beyond. Following up the coast one comes to Worth point and from here on the place marked Haswell point long lagoons edged by sandspits border the land. Haswell point itself is really an island and both north and south of it another island will be noticed.

From Haswell point to Meek point the map is fairly accurate except that there is scarcely so deep a bight so close to the former; it is more in the middle distance. Terror island lies directly off Meek point and lies most east and west. For three miles past here the coast runs north of east but then turns south to form a bight in an inlet ten miles wide and fifteen or more deep which is not charted on the map. From Wolley point on towards cape Collins, lagoons are found most all the way, and from here onward the map is so incorrect that it is difficult to refer to it at all. Burnett bay does not exist but in its place is the low flat delta of a fair-sized river across the mouth of which lies an island, fifteen miles long and five hundred feet high at the highest point. Norway island is more off the place marked Pennell point and from here north the coast does not recede so much as one would think from off the shore for the hills beyond the flat land take the direction indicated on the chart.

Robilliard island seems about correct but from here onward in the direction of cape Alfred, a chain of islands extends all the way. There are but two Gore islands in the position indicated by the chart but the largest point of land at cape Prince Alfred is an island leaving a pointed sandspit for the cape. A conspicuous round topped hill can be noticed a mile or so south of the real cape. It is only fair to remark that when travelling from the north to the south from cape Alfred and some distance off-shore that the land has the appearance indicated by the chart. About twenty miles northeast along the coast from cape Alfred a low sandy island stretching across the mouth of a deep fiord would seem to make a good harbour for a boat. We had not time to sound this place but a few odd cakes of ice amongst the smooth would suggest a channel of at least twenty feet in depth.

About cape Clifford a river bed about two miles wide cuts through the hills from the high plateau behind and forms a break in the range which gradually increases in height from cape Alfred. About three miles further along another branch of the same river runs into the sea, making the intervening section practically an island. On the southwest branch of this river, and near the coast there is a beacon, but we could not find any trace of a record having been left.

Another few miles along the coast another small river enters the sea through steep-sided banks and on the banks of this river and about seven miles inland I found seams of coal. There is scarcely a distinctive point in the vicinity of cape Wrottesly, but just thereabouts there is a large lagoon, the outside barrier of which is a very low and inconspicuous sandspit. However the coast turns in a more easterly direction with a gradual change as far as cape McClure. Cape McClure is bold and precipitous and somewhat resembles cape Lambton in appearance. Here again the map is very deceptive for one cannot find a conspicuous point where cape Crozier is marked on the map, and although the coast turns almost south it does not make any westing but bends gradually towards cape Clifton, then some eight miles west of Providence point one finds a bay some three miles wide and ten miles deep, into the bottom of which empties a large river which Mr. Stefansson and his party followed in the summer of 1915 and will doubtless describe. I did not traverse the coast from Mercy

bay to John Russel point, but from this point to Milne point the coast line seems fairly accurate.

In general topography Banks island has the appearance of a high range of hills, whose peak is about 2,000 feet high and is within forty miles of Nelson head. The range runs from Nelson head to cape McClure ending abruptly at each end, with a high plateau in the centre of the island, but this a little lower than either end. On the western side it slopes gradually down towards the sea and the greatest watershed is in that direction. On the eastern side from Nelson head to Johnson bay the land slopes steeply down and the whole north-west corner is hilly. Numerous small lakes dot the landscape and several large ones ten miles long and two or more miles wide were found. One is eight miles inland directly opposite Armstrong point, and another a few miles north-west of that. Another is a few miles inland from Thesiger bay. We had no means of getting at their depths.

When following the Victoria land coast along the Prince of Wales straits one notices that Dean Dundas bay is not so deep by about five miles as it is mapped. Ramsay island would appear to be a good deal further south than it is marked, and the straits in this vicinity seem wider, but as we had no sextant with us we could not locate our positions accurately. The western coast of Victoria island is fairly low until one comes to Walker bay. From here mount Phayre is a very conspicuous round-topped hill. Cape Wollaston itself is low, but a high-cut bank a few miles east looms up noticeably. From Holman island one can see mount Arrowsmith, but not the island charted in the sound. This we found to be really two islands much more in the centre of the mouth of Prince Albert sound than charted. Cape Kendall is undoubtedly an island, and the high cliffs near point Williams are conspicuous. No sign was seen of Clerk island although we passed several times in that locality.

Ice Conditions.—The ice conditions met with on the *Karluk* during 1913 have no doubt been reported on.

The rivers had broken out by May 23, 1914, in the vicinity of point Barrow, but I was able to travel from that place by sled leaving on May 25—to Clarence lagoon in Canadian territory reaching the latter place on June 14. Travelling for the greater part of the distance at that time of the year was very uncomfortable owing to the waters of the rivers having flooded the smooth lagoon ice, and consequently forcing us to travel off shore over the rough pack ice. Even here the water had soaked under the crust of snow and on warm days one would repeatedly break through. On other occasions it was necessary to travel through the water which was often so deep that the dogs had to swim and the men push the sled.

The season at point Barrow in 1914 when we left was equally as much advanced as that at Collinson point when we arrived here on June 5th, but during the next few days at this place the snow disappeared very rapidly. At Clarence lagoon on the 14th most of the snow had disappeared from the ground, the water had melted holes in the ice and the solid ice had risen and was comparatively dry once more. Around the river mouths it was honey-combed and rotten, but off shore the travelling was fairly good. It was impossible to get on to lagoon ice or lakes at this time of the year in this vicinity for the fringe of open water round the edges, but we continued to travel on the sea ice until June 20th. The first general movement in the ice along the beach was on June 29th when it piled up on the sandspits to a height of twenty feet or more. The lagoon was clear of ice by July 6th and we were able to navigate the *Mary Sachs*. After several days of northeast wind the ice opened and scattered on the 18th, but it settled back again when the wind failed the next day. By the 23rd it had opened up again and we went out of the lagoon and proceeded to Herschel island having little difficulty with the ice.

One large steam whaler had reached the island from a little further down the coast some two days earlier, and another came in three days later. The Mackenzie river boats were late, however, and did not reach the island until August 7th, having been held up by pack ice to the eastward. Leaving Herschel island on the 4th we passed through scattered floes until we reached Richard island and here we were held up by the ice for two days. A westerly wind shifted it along the beach ahead of us and we reached the Baillie islands without much trouble with the ice. East of here the straights seemed packed with ice, but a few days of easterly wind cleared it out and we proceeded to Pierce point and across to Banks island in open water. Westerly winds had set in again by the time we reached this coast and had packed the ice in along the coast and in Thesiger bay. However as we neared cape Kellett on Aug. 26th, it appeared as though the ice had never left the beach in this vicinity. However one or two small rivers had melted out the ice to some extent and after a great deal of bucking and manœuvering we brought the schooner in beside the beach on Sept. 1st. Young ice had been forming each night for several nights and cementing the older floes together, and around cape Kellett and as far west as we could see, there was solid floe ice. To the south and away to the north we could see the streaks of water sky, but there were no means of reaching it.

On September 10th, during a storm, the ice cleared away from the beach leaving the southern and western coasts free for navigation. However the main pack ice never shifted far off the western coast, but remained off shore; while the sea froze over solid enough to travel on by the 21st. Cracks and open leads of water appeared to the south and west of cape Kellett at intervals during the winter, but the ice had little motion. Travelling along the whole west coast of Banks island one could see that there had been open water there during the fall, for there was little old ice near the beach. On the north coast from cape Alfred the ice was much broken up and we had evidence of much motion in the ice during the winter as far east as cape McClure.

During the months of February and March of both 1915 and 1916, and, as a matter of fact, at intervals all through the winter, there were leads of open water in the vicinity of cape Alfred. The general drift of the ice in this vicinity was towards the west, but the same floes that went out would sometimes drift back again. At cape Kellett by the 1st of May, 1915, the sandspits were bare of snow, but during the early part of May the snow on the inland slopes was hard and made a good surface for travelling over. In fact, the ice and snow conditions remained excellent for travelling over until we reached the Dolphin and Union straits on the 21st of May, en route from Kellett, Banks island to Bernard harbour. Along the coast from here and across the Coronation gulf to the mouth of the Coppermine river the travelling was good until the 1st of June.

The season seemed particularly late in that vicintiy in 1915 and on the 21st of June there were still three feet of snow in drifts around the tents and many patches on the land. It was the 20th of July before we could move the boat in the harbour and not until the 9th of August that we could proceed along the coast to Coronation gulf. We had some trouble in getting through the straits past Lambert island but once in the gulf we had clear water as far east as cape Barrow. Leaving cape Barrow on the 11th of August, we reached Baillie island on the 11th without having encountered any ice on the way. On the 16th we crossed the straits to cape Kellett in the *North Star* without trouble and found the Banks island southeast coast practically clear of ice. The heavy pack was never far from the western shore. Starting from cape Kellett on the 26th we proceeded north close to the beach, but it was only on account of the shallow draft of our vessel—4 feet, 6 inches—that we were able to pass between the heavy pack and the beach, as far as Norway island. At this place and further north the ice was still solid on the beach, and only moved out for a few miles

further for the next few days. By the 20th of August, we had reached just north of Robilliard island but further north than here the ice never left the beach in 1915.

A westerly wind drove the pack inshore along the coast as far as we could see and by the 10th of September we could walk anywhere across the frozen sea. It would seem that in only exceptionable years that a boat could proceed along the whole west coast of Banks island for the ice does not appear to move far off the shore, and the open season is so very short in any case. During 1916 I was able to travel from Armstrong point to Coronation gulf, leaving the former place on June 1st, and arriving at the latter on June 13th; but this was just about as late as one could have travelled that year, and even then we had to use a sled raft to cross a number of the tide cracks. Most of the way we travelled through six inches or more of pen water and across the Dolphin and Union straits the ice was very thin and rotten. 1916 was a very much earlier season in this vicinity than 1915, for we took a boat from the same position as the year before some four weeks earlier.

In 1914 Banks island was covered with snow for the winter on the 12th of September, although it had been snowed over and melted off a day or two before. In 1915 the ground was covered at cape Prince Alfred by the 8th of September.

Fuel on Banks island.—There is a little driftwood to be found on the east, west and south coasts of Banks island, but none at all, except a few chips, on the north coast. On any part there is scarcely enough to keep a big camp fire going for a twelve-month within a stretch of fifteen miles and more often not so much. During the summer there is an abundance of heather to be found on the inland slopes but very little willow. Wood is sometimes found many miles inland projecting from the banks of rivers and even on the hilltops, but this is not to be depended on for fuel. The coal deposits near the northern coasts may prove useful, judging from the samples taken, for they would burn well when lighted on a primus stove. We had no means of testing it in a camp stove. However, one is always well advised to carry fuel oil in strong containers when travelling about the island.

Game, Fish, etc.—Caribou may be found on Banks island at each season of the year, but they are comparatively scarce at all times and need a deal of hunting for. They are in their prime from September until the end of November, but are hardly worth killing during March, April, May and part of June. Their skins are not so satisfactory as those of the mainland caribou, or the domestic deer for clothes although they can be used.

Seals are fairly numerous near the shore of all the islands and can most always be obtained at Nelson head, cape Kellett and cape Alfred during the winter in the leads that form in the ice. In the spring they can be shot while on the ice asleep, but this is not by any means an easy matter for they are difficult to approach. In the summer they seem to float if they are killed quite dead, and the wound is not too large, but late in the fall they float more readily.

Polar bears are comparatively numerous along the coast, although their presence may have been due in the neighbourhood of cape Kellett to a stranded whale carcass. Along the north and south coasts the open leads of water no doubt keep them near the land, and many are found travelling along the Prince of Wales straits. The Eskimo hunt them each year in the vicinity of Nelson head, and during the early spring one man told me that he had followed a bear so far out on the ice that he had seen the land on the other side of the straits.

Ducks and white geese are very numerous around cape Kellett in the spring and may be on the other part of the island for all we know. During the summer the white geese especially can be driven about in flocks when they are moulting and killed like sheep. At this time of the year they are not so very fat and are much better if killed earlier in the season. Curiously enough from some 250 geese that were killed at cape Kellett during the summer of 1915, only one was found to be a female and only one egg was found during the season.

Ptarmigan are fairly numerous on the coasts in early spring, but not so plentiful as on the mainland. Many schools of fish were seen swimming in the water and the Eskimo tell us that they are plentiful in the large lakes on the island. We had a net set from a sandspit but only caught one fish. The women caught several dozen Tom-cod through the ice one fall, but we had not time to give the fishing much attention. On Victoria island the fish are very plentiful in lakes and the local Eskimo seem to catch a lot in spring and fall.

Clothing.—We found the native method of dressing with fur clothes next the skin to be most suitable for extensive travel, although when frequent changes can be had, woollen clothes are very comfortable. I also found a woollen mask that fitted closely to the face having two holes for the eyes and one for the mouth and nose, a great protection from the frosty wind. It is essential, however, that this garment should fit tightly to the face, and also that the edges of the openings are far enough away from the nose and mouth to prevent the breath melting the hoar frost which forms outside and making ice. Although I travelled at times under severe conditions I never had a frost bite on the face while using the woollen face-mask.

I found fur socks most serviceable and comfortable if a very thin woollen, sock was worn next to the feet, but the care of the feet in the Arctic is a personal equation differing with each individual. Polar bear skin or domestic sheepskin mittens are most satisfactory in comparatively warm weather, but in very cold weather we found nothing that was entirely satisfactory if one was going a long journey without the chance to dry one's clothes. Well-fitting dog or wolf skin, covered with canvas, are about the best.

Winter Travel along the west coast of Banks island.—It is quite possible to travel along the coast in winter, although the temperature might average —25 degrees F. or more, and the sun does not appear for two months. However, on the western coast of the island it is more difficult than in most places, for the land is so low-lying that by lantern light it is difficult to tell when one is wandering inland and the only means of knowing in most cases is by digging through the snow at frequent intervals to see if one is still on the sea ice.

Snow Houses.—We found the building of snow houses practicable from the middle of October to the middle of May, and much preferred to live in them than tents. Their greatest drawback is perhaps the length of time they take to build. A house 12 feet in diameter, big enough to accommodate seven people can scarcely be put in condition to live in, in less than two hours by four men. It more often takes three hours, depending on the quality of the snow with which one has to build. Once the principle is grasped it requires but little skill to build a house of snow, but quite a deal of art and skill are required to build a perfect dome-shaped one, which type is by far the best.

Dog Sickness.—Dog sickness of a kind peculiar to the Polar regions is always a worry to the Arctic traveller. It attacks the dogs most frequently in spring time, although we had one dog die of it in winter. The symptoms, though generally alike, differ with each individual attacked. Persistent mournful howling and a restlessness were usually the first symptoms noticed, and the dog would then gnaw anything which it could reach. This would be followed in a few hours by apparent paralysis of the muscles of the throat. While no inflammation was noticeable, it was impossible for the dog to swallow a morsel of food, even if it was placed in the mouth. The dog was evidently in great pain and could not rest. In two days their eyes would be glazed and sunken and the next day they would invariably die.

I am, sir, your obedient servant,

GEO. H. WILKINS,
Photographer.